

# **NOTICE:**

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The Administrative Record Staff

RF/RMRS-96-0061



**FINAL  
SITE SPECIFIC HEALTH  
AND SAFETY PLAN  
FOR THE SOURCE  
REMOVAL AT THE  
MOUND SITE IHSS 113**

NO PGS  
206-208



**FEBRUARY 1997**

ADMIN RECORD

**Site Specific Health and Safety Plan  
for the Source Removal at the  
Mound Site IHSS 113**

**Rocky Mountain Remediation Services, L.L.C.**

**February 1997**

### ADMINISTRATIVE INFORMATION

Site Rocky Flats Environmental Technology Site (RFETS), Golden, Colorado  
Project Name Source Removal at the Mound Site - IHSS 113  
Date Prepared February 28, 1997

#### Approvals

I have read and approved this HASP with respect to project hazards and regulatory requirements



Wayne Sproles  
RMRS - Project Manager

3/3/97

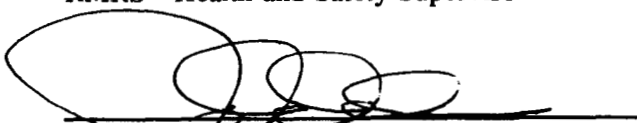
Date



M D Schreckengast  
RMRS - Health and Safety Supervisor

3/3/97

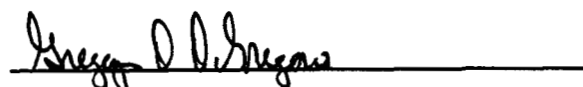
Date



Jerry Anderson  
RMRS - Radiological Coordinator

3/3/97

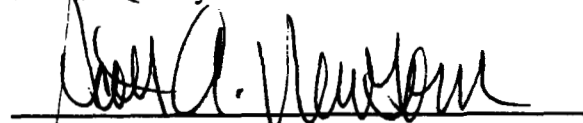
Date



Greg DiGregorio  
RMRS - Quality Assurance

3/3/97

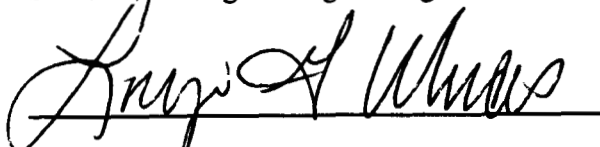
Date



Scott Newsom  
SSOC - Radiological Engineering

3/3/97

Date



Lorenzo Ubras  
SSOC - RMRS Radiological Safety Section Manager

3/3/97

Date



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## REFERENCES

- American Conference of Governmental Industrial Hygienists *Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices* 1995-1996
- Department of Energy (DOE) Order 5480 9A, *Construction Project Safety and Health Management*
- Department of Energy (DOE) Form F5480 4, *Complaint Form*
- Department of Energy (DOE) Form 5484 3, *Individual Accident/Incident Report*
- DOE Title 10 CFR 855 *Occupational Radiation Protection*
- DOW Chemical Company, Rocky Flats Division *Letter from R M Vogel to E A Putzier titled "Logistics of Mound Excavation " dated September 11 1970*
- Kaiser-Hill *Auditable Safety Analysis for the Mound Site Source Removal Project*
- *NIOSH Pocket Guide to Chemical Hazards* 1994
- OSHA Title 29 CFR 1904 *Recording and Reporting Occupational Injuries and Illnesses*
- OSHA Title 29 CFR 1910 *Safety and Health Regulations for General Industry*
- OSHA Title 29 CFR 1926 *Safety and Health Regulations for Construction*
- OSHA Title 29 CFR 1926 65 *Hazardous Waste Operations and Emergency Response*
- Rocky Flats Environmental Technologies Site *Administrative Procedures Manual*  
ADM-16 01 *Occurrence Reporting Process*
- Rocky Flats Environmental Technologies Site *Conduct of Operations Manual*  
COOP-006 - *Operating Area Logs and Records*
- Rocky Flats Environmental Technologies Site *Field Operations Manual*  
FO 01 - *Air Monitoring and Dust Control*  
FO 03 - *Field Decontamination Operations*  
FO 04 - *Decontamination of Equipment at Decontamination Facilities*  
FO 06 - *Handling of Personal Protective Equipment*  
FO 07 - *Handling of Decontamination Water and Wash Water*  
FO 12 - *Decontamination Facility Operations*
- Rocky Flats Environmental Technologies Site *Health and Safety Practices Manual*  
HSP-2 08 *Lockout/Tagout*  
HSP-Section 4 - *Medical Program*  
HSP-9 06 *Powered Industrial Trucks*  
HSP-12 10 *Hand and Portable Power Tools*  
HSP-18 07 *External Radiation Dosimetry*  
HSP-18 10 *Radiological Material Transfer and Unrestricted Release of Property and Waste*  
HSP-18 20 *Routine Bioassay Monitoring Program*  
HSP-21 04 *Emergency Response and Spill Control*
- Rocky Flats Environmental Technology Site *Radiological Control Manual*

- Rocky Flats Environmental Technologies Site *Radiological Operating Instructions Manual*
  - ROI-2 01 *Personnel Contamination Monitoring*
  - ROI-3 01 *Performance of Surface Contamination Surveys*
  - ROI-3 02 *Radiological Requirements for Unrestricted Release*
- ROI-4 02 *Air Sampling*
- ROI-4 03 *Portable Low Volume Air Sampling*
- Rocky Flats Environmental Technologies Site *Soil Disturbance Permit #CB0340PL, Site Preparation Activities for Mound "Source Removal"*
- Rocky Flats Environmental Technologies Site *Soil Disturbance Permit #CB0340PL, IHSS 113, "Source Removal Action" (Mound Site)*
- Rocky Mountain Remediation Services *Field Implementation Plan for the Source Removal at the Mound Site, IHSS 113*
- Rocky Mountain Remediation Services *Heat Stress Monitoring Procedure (Discussed in letter #RJC-014-96 )*
- Rocky Mountain Remediation Services *Integrated Work Control Package #T0090239, Source Removal at the Mound Site*
- Rocky Mountain Remediation Services *Proposed Action Memorandum for the Source Removal at the Mound Site, IHSS 113*
- Rocky Mountain Remediation Services *Sampling and Analysis Plan to Support the Source Removal at the Mound Site, IHSS 113*
- Section 01700-1 *Subcontractor Health and Safety Requirements (9/23/96)*
- SW 01 (1-C91-ERP-SW 01) *Control and Disposition of Incidental Waters*

## LIST OF ACRONYMS

ACGIH	American Conference of Governmental Industrial Hygienists
AIHA	American Industrial Hygiene Association
ALARA	As Low As Reasonably Achievable
ANSI	American National Standards Institute
COC	Chemical of Concern
CPM	Counts Per Minute
CRZ	Contamination Reduction Zone
CSFS	Contaminated Soil Feed Stockpile
DAC	Derived Air Concentration
dB	Decibels
DOE	Department of Energy
EZ	Exclusion Zone
FID	Flame Ionization Detector
FIDLER	Field Instrument for the Detection of Low Energy Radiation
FIP	Field Implementation Plan for the Source Removal at the Mound Site, IHSS 113
FO	Field Operations Manual
GFCI	Ground Fault Circuit Interrupter
HASP	Health and Safety Plan
HSP	Health and Safety Practices Manual
HSS	Health and Safety Specialist
IHSS	Individual Hazardous Substance Site
KH	Kaiser-Hill
MDC	Minimal Detectable Counts
MSDS	Material Safety Data Sheet
NIOSH	National Institute of Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PAH	Polycyclic Aromatic Hydrocarbons
PAM	Proposed Action Memorandum for the Source Removal at the Mound Site, IHSS 113
PCB	Polychlorinated Biphenyls
pCi/g	Pico Curies Per Gram
PID	Photoionization Detector
PPE	Personal Protective Equipment
PPM	Parts Per Million
RBA	Radiological Buffer Area
RCT	Radiological Control Technician
RFETS	Rocky Flats Environmental Technology Site
ROI	Radiological Operating Instructions Manual



<b>RMRS</b>	<b>Rocky Mountain Remediation Services</b>
<b>RTG</b>	<b>Resource Technologies Group</b>
<b>RWP</b>	<b>Radiological Work Permit</b>
<b>SAP</b>	<b>Sampling and Analysis Plan to Support the Source Removal at the Mound Site,</b> <b>IHSS 113</b>
<b>SCA</b>	<b>Soil Contamination Area</b>
<b>SCBA</b>	<b>Self Contained Breathing Apparatus</b>
<b>SEG</b>	<b>Scientific Ecology Group</b>
<b>SSO</b>	<b>Site Safety Officer</b>
<b>SSOC</b>	<b>Safe Site of Colorado</b>
<b>SVOC</b>	<b>Semi-Volatile Organic Compound</b>
<b>TDU</b>	<b>Thermal Desorption Unit</b>
<b>VOC</b>	<b>Volatile Organic Compound</b>
<b>WBGT</b>	<b>Wet Bulb Globe Thermometer</b>

## 1 0 INTRODUCTION

This site specific Health and Safety Plan (HASP) addresses the hazards associated with each phase of site operation and establishes guidelines to protect project personnel, collocated workers, the general public, equipment, and the environment during the implementation of field activities associated with the Source Removal Action at the Mound Site, IHSS 113. This work will be conducted as an accelerated action under the Final Proposed Action Memorandum for the Source Removal at the Mound Site, IHSS 113 (PAM).

This work will adhere to the regulations and guidelines outlined in Occupational Safety and Health Administration (OSHA) Title 29 CFR 1926.65 Hazardous Waste Operations and Emergency Response, Department of Energy (DOE) Order 5480.9A, Construction Project Safety and Health Management," and DOE Title 10 CFR 835, Occupational Radiation Protection. When not addressed in OSHA Title 29 CFR 1926.65, all nonradiological work will be performed in accordance with Title OSHA 29 CFR 1910 Safety and Health Regulations for General Industry or OSHA Title 29 CFR 1926 'Safety and Health Regulations for Construction.

In addition to this HASP, an Auditable Safety Analysis was prepared and is included in Appendix A.

The specific activities to be performed are defined in Section 4.0 of this HASP. The health and safety guidelines and requirements presented are based on a review of available information and an evaluation of potential hazards. This HASP outlines the health and safety procedures and equipment required for activities at this site to minimize the potential for exposures of field personnel. Revisions to this HASP require approval from the RMRS Project Manager, RMRS Radiological Coordinator, RMRS Health and Safety Supervisor, RMRS Radiological Safety Section Manager, and SSOC Radiological Engineering.

This HASP applies to Rocky Flats Environmental Technology Site contractors, subcontractors, and visitors involved in operations, management, or administration at the Mound Site.

## **2 0 PROJECT PERSONNEL RESPONSIBILITIES**

The responsibilities and authorities of each individual relating to health and safety issues are presented below. The project Health and Safety Organization is shown in Figure 2.1. A project phone list is presented in Table 2.1.

### **2.1 ALL PERSONNEL**

Each person is responsible for the health and safety of themselves and their coworkers, for completing tasks in a safe manner, and reporting any unsafe acts or unanticipated hazards or conditions to the Project Manager, Site Safety Officer, or the Health and Safety Specialist. All personnel are responsible for continuous adherence to this HASP during the performance of their work. No person may work in a manner that conflicts with the safety and environmental precautions expressed in this document.

### **2.2 RMRS VICE PRESIDENT OR DESIGNEE**

The RMRS Vice President or designee is responsible for the following:

- Liaison activities between Kaiser-Hill Environmental Restoration management and RMRS Project management,
- Providing assistance to the Project Manager, and
- Issuing approval for restart of the project following suspension of activities.

### **2.3 PROJECT MANAGER**

The Project Manager is responsible for overall operations during fieldwork on the site including the health and safety of project personnel during site activities. The project manager is responsible for implementation of the HASP and protecting surrounding facilities and any potentially affected communities. The Project Manager's specific health and safety duties include the following:

- Managing the development and implementation of the site specific HASP and Activity Hazard Analyses,
- Performing periodic on site inspections to make certain that the HASP is being followed,
- Coordinating with the Site Safety Officer and Health and Safety Supervisor on health and safety matters,
- Ensuring that resources are available for all health and safety requirements,
- Providing the appropriate monitoring and safety equipment necessary for implementing this HASP,
- Suspending field activities if health and safety of personnel are endangered pending an evaluation by the Site Safety Officer or the Health and Safety Supervisor,
- Suspending field activities for radiological safety issues and consulting with Radiological Safety.

Figure 2 1  
 Project Organization

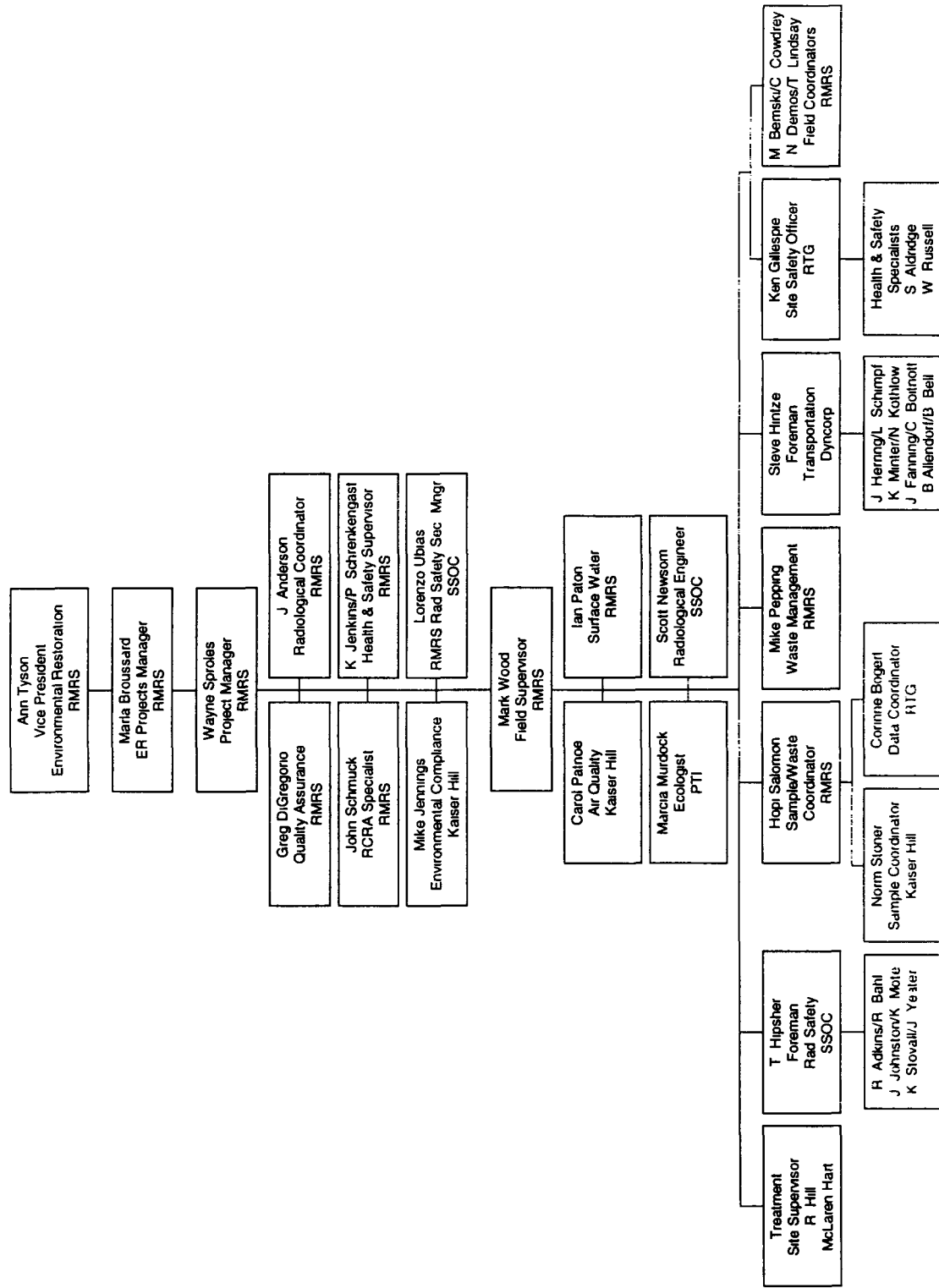


Table 2 1  
Project Phone List

Name	Company/Title	Phone	Pager	Radio	Home
Adkins Rich	KH RCT	2397		-	
Aldridge Steve	RMRS Contractor HSS			3719	938-1809
Allendorf Brett	KH Transportation	4530			
Anderson Jerry	RMRS Rad Coordinator	6438	7447		
Bahl Robert	KH RCT	2397			-
Barnes Dave	RTG - Health and Safety Specialist	5352	3542	3748	989-6003
Batson Cherry	RMRS Site Access Coordinator	3542	6126		463-3214
Bell Briant	KH Transportation	4530	-	-	
Boitnott Clarence	KH - Transportation	4530	-		
Broussard Marla	RMRS Field Operations Manager	6007	4010	3740	530-5562
Casillas Andrea	RMRS - Field Operations Yard	5302	1227	3802	-
Chandler Skip	RMRS H&S Team Leader	6673	3806	1659	452-4199
Cirillo Russ	RMRS Bldg 891 Water Treatment	5876	5477	3765	431-6389
Cowdery Craig	RMRS - Project Support	6953	5466	3743	-
Coyne Dan	RMRS - Maintenance	8177	7223	3411	-
Demos Nick	RMRS - Project Support	4605	3842	3810	-
DiGregorio Greg	RMRS - Quality Assurance	5688	1732	-	
Fanning Joe	KH Transportation	4530		-	
Garcia Rich	SEG - Waste Tech Supervisor	6616	7509	4838	
Gillespie Ken	RTG Site Safety Officer	5356	4007	3733	665-7607
Herring Jeff	KH - Transportation	4530			
Hintz Steve	Dyncorp - Transportation Foreman	4530	4269	4106	
Hipsher Tim	SSOC Rad Operations Foreman	2397	3369	3271	
Johnston J	KH RCT	2397			
Jenkins Ken	RMRS H&S Team Leader	5374	7455	4505	751 7797
Kothlow Neil	KH Transportation	4530			
Lindsey Tom	RMRS Project Support	5705	7478	3776	
Minter Kerry	KH Transportation	4530	-	-	
Mote Kathy	KH RCT	2397	-		
Newsom Scott	SSOC Radiological Engineer	8148	3977	3242	460-1680
Parson Gary	KH Excavation Specialist	4197	1899	4533	-
Patnoe Carol	KH Air Quality	2440			
Paton Ian	RMRS Surface Water	2680	5238	-	-
Pepping Mike	RMRS Waste Generator	3075	7464	3808	278-8095
Russell Wade	RTG - Health and Safety Specialist	5356	6136	3728	451-6668
Salomon Hopi	RMRS Sample/Waste Manager	6627	5129	3779	561-0858
Schimpf Lou	KH Transportation	4530	-		
Schreckengast Peggy	RMRS - H&S Supervisor	6790	3059	3702	344-1264
Sieben Ann	KH Program Manager	9886	4482	3769	831-4320
Sproles Wayne	RMRS Project Manager	5790	1245	3798	255-9984
Stoner Norm	KH Environmental Lab	4289			828-4525
Stovall Kent	KH RCT	2397			

Field Change No 7

Field Change No 2

**Table 2 1**  
**Project Phone List (cont )**

Name	Company/Title	Phone	Pager	Radio	Home
Tyson Ann	RMRS VP Env Restoration	4829	1011		420-2475
Ubias Lorenzo	SSOC RMRS Rad Safety Sec Mngr	8231	5507		
Wood Mark	RMRS Field Supervisor	6689	5904	3796	670-8928
Yeater Judy	KH RCT	2397			

- Suspending individuals from field activities for infractions of the HASP pending an evaluation by the Site Safety Officer and/or the Health and Safety Supervisor
- Ensuring that proper controls and work practices are in place following any unanticipated hazard or condition including necessary changes to the HASP or Activity Hazard Analyses,
- Escorting employees with injuries or illnesses to RFETS Medical
- Implementing emergency procedures as required and
- Assisting in accident investigations and implementing corrective actions to any unsafe conditions

#### **2 4 HEALTH AND SAFETY SUPERVISOR**

The Health and Safety Supervisor is responsible for overall compliance with and implementation of the HASP The Health and Safety Supervisors responsibilities are as follows

- Develop health and safety requirements for the project,
- Assist in the development of the site specific Activity Hazard Analyses and the HASP,
- Approve the site specific Activity Hazard Analyses and the HASP
- Approve all changes to the site specific Activity Hazard Analyses and the HASP,
- Provide health and safety assistance to the Site Safety Officer (SSO) and Health and Safety Specialists (HSS)
- Provide assistance to the SSO and HSS in addressing health and safety issues which cannot be solved in the field
- Conduct weekly health and safety inspections of the project,
- Ensure prompt reporting of all accidents and incidents and
- Maintain all required health and safety statistical information pertinent to employee hours worked

## **2 5 SITE SAFETY OFFICER (SSO)**

The SSO is responsible for on site compliance with and implementation of the HASP. The SSO and ultimately the Project Manager are responsible for the safe conduct of operations. The specific health and safety duties of the SSO include the following:

- Develop the site specific Activity Hazard Analyses and the HASP,
- Reporting to the Health and Safety Supervisor and the Project Manager on health and safety matters,
- Providing a copy of the HASP to all field crews,
- Ensuring that current medical clearance and training documentation is available,
- Obtaining required health and safety equipment and maintaining equipment on the site,
- Conducting daily pre-work health and safety briefings,
- Conducting daily site health and safety inspections and immediately correcting all deficiencies,
- Supervising the Health and Safety Specialists,
- Immediately reporting all safety-related incidents or accidents to the Health and Safety Supervisor and the Project Manager,
- Overseeing or conducting required health and safety monitoring such as air contaminant, noise, and heat or cold stress monitoring,
- Maintaining a health and safety log including monitoring results and observations,
- Suspending work or otherwise limiting personnel exposures if this HASP appears to be unsuitable or inadequate, or if the health or safety of personnel is endangered, and
- Implementing emergency procedures as required

## **2 6 HEALTH SAFETY SPECIALIST (HSS)**

The HASP for the Mound Site Source Removal is implemented by the HSS. The specific health and safety duties of the HSS include the following:

- Assisting the Site Safety Officer in implementing the HASP,
- Reporting to the Site Safety Officer and the Field Supervisor on health and safety matters,
- Assisting the Site Safety Officer in conducting daily pre-work health and safety briefings,
- Immediately reporting all safety-related incidents or accidents to the Site Safety Officer and the Field Supervisor,
- Conducting required health and safety monitoring such as air contaminant, noise, and heat or cold stress monitoring,
- Maintaining a health and safety log including monitoring results and observations,
- Directing personnel to change work practices if existing practices are deemed to be hazardous to the health and safety of personnel, and
- Implementing emergency procedures as required

## **2.7 FIELD SUPERVISOR**

The Field Supervisor, in coordination with the Project Manager and the Site Safety Officer, will be responsible for the implementation of this HASP. This will include communicating site requirements to all on site project personnel. The Field Supervisor's specific health and safety duties include the following:

- Enforcing the requirements of the HASP,
- Suspending work, as required, to ensure personal safety and protection of property, or where life or property-threatening non-compliance with safety requirements is found,
- Ensuring site permits are obtained before work begins at each site,
- Notifying the Project Manager of any accidents, spills, or emergencies,
- Informing facility personnel of activities that will be carried out on a particular day,
- Communicating with the Site Safety Officer about the schedule of work at the facility,
- Ensuring that all site personnel have been given the proper medical clearance,
- Ensuring that all site personnel have met appropriate training requirements and have the appropriate training documentation at the site,
- Conducting daily site health and safety inspections and reporting all unsafe conditions to the Site Safety Officer,
- Implementing corrective actions to any unsafe conditions, and
- Implementing emergency procedures as required.

## **2.8 RADIOLOGICAL CONTROL TECHNICIANS AND RADIOLOGICAL ENGINEERING**

The radiological engineer and radiological control technicians (RCTs) will be responsible for implementation of the HASP. This includes communicating site radiological conditions to all on site project personnel and consultation with the Field Supervisor and the Project Manager. The specific duties of the Radiological Engineer and the RCTs include the following:

- Implementing radiological guidelines,
- Preparing the Radiological Work Permits (RWP) and posting the area appropriately,
- Coordinating and documenting activities to limit radiation exposures to levels that are As Low As Reasonably Achievable (ALARA),
- Performing radiological surveys of soils, equipment, and personnel,
- Performing radiological air monitoring,
- Documenting and submitting copies of all formalized radiological surveys and air monitoring data to the Project Manager or Field Supervisor,
- Maintaining a log of pertinent observations, and
- Suspending work in accordance with the Radiological Work Permit (RWP) if health or safety of personnel or the environment is endangered.



## **2.9 SUBCONTRACTORS**

Subcontractors will implement and follow this plan. The following specific responsibilities are included:

- Attend site specific orientation and follow the requirements set forth in this plan,
- Provide Site Safety Officer with copies of Material Safety Data Sheets (MSDS) for all hazardous chemicals brought on the site, and
- Provide copies of all required training and medical authorizations to the Site Safety Officer

### **3 0 SITE INFORMATION**

### **3 1 ROCKY FLATS ENVIRONMENTAL TECHNOLOGIES SITE (RFETS)**

#### **3 1 1 RFETS Location**

RFETS is located in northern Jefferson County, Colorado, approximately 16 miles northwest of Denver. The cities of Boulder, Broomfield, Westminster, and Arvada are located less than 10 miles to the north, northeast, east, and southeast, respectively. RFETS consists of approximately 6,550 acres and occupies Sections 1 through 4 and 9 through 15 of Township 2 South, Range 70 West, 6th Principal Meridian. Major plant buildings are located within an RFETS security area of approximately 400 acres. The security area is surrounded by a buffer zone of approximately 6,150 acres. RFETS is generally bounded on the north by State Highway 128. To the east is Jefferson County Highway 17, also known as Indiana Street. To the south are agricultural and industrial properties and State Highway 72, and to the west is State Highway 93. A RFETS location map is shown in Figure 3.1.

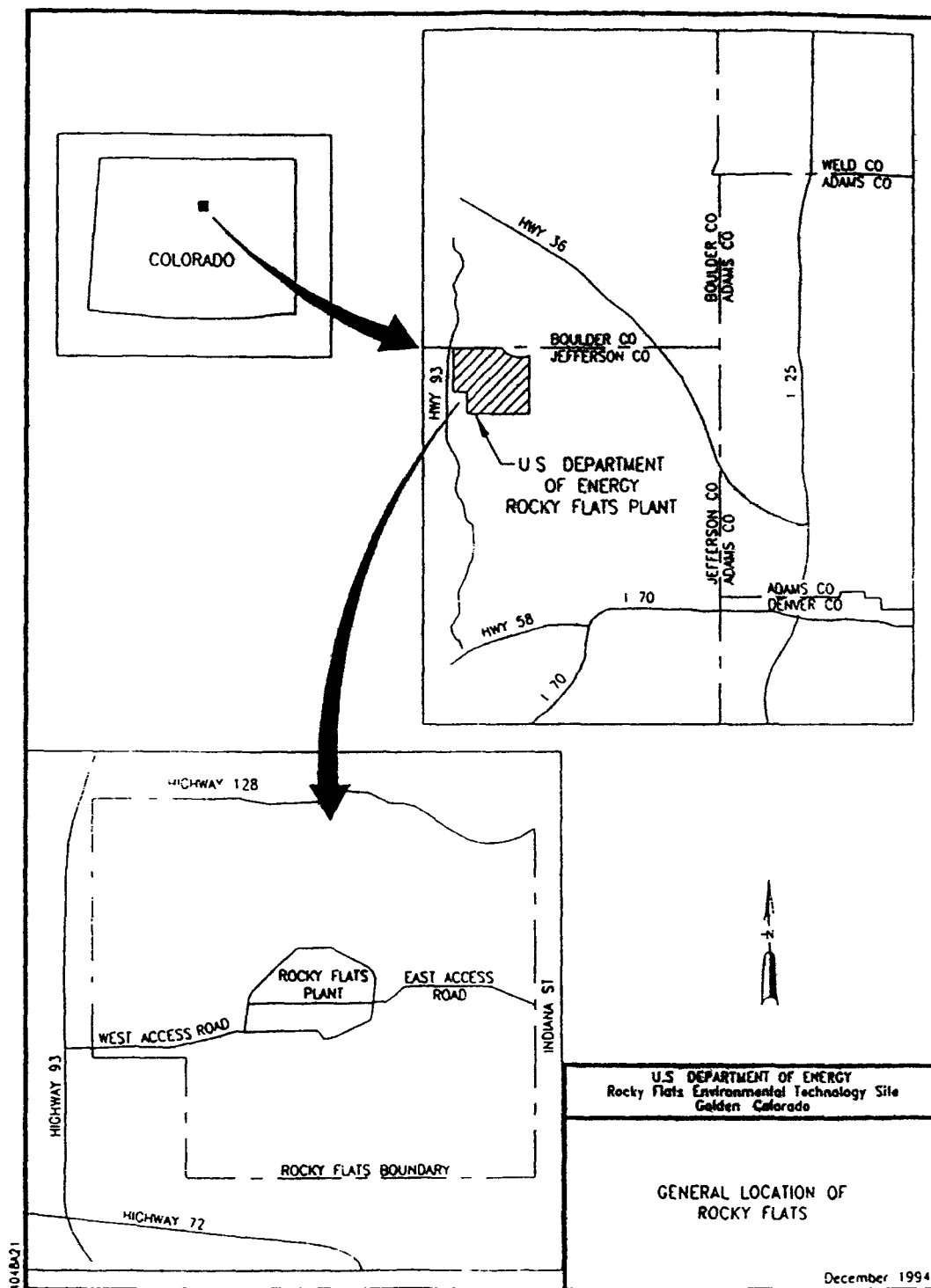
#### **3 1 2 RFETS Background**

RFETS is a government-owned and contractor-operated facility that is part of the nationwide nuclear weapons production complex. It was operated for the U.S. Atomic Energy Commission (AEC) from RFETS's inception in 1951, then known as the Rocky Flats Plant, until the AEC was dissolved in January 1975. Then, responsibility for Rocky Flats Plant was assigned to the Energy Research and Development Administration (ERDA), which was succeeded by the Department of Energy (DOE) in 1977. Dow Chemical USA, an operating unit of the Dow Chemical Company, was the managing and operating contractor of the facility from 1951 until June 30, 1975. Rockwell International succeeded Dow Chemical USA from July 1, 1975 to January 1, 1990. EG&G Rocky Flats, Inc. succeeded Rockwell International and operated the plant from January 1, 1990 to July 1, 1995. The plant name was changed to Rocky Flats Environmental Technologies Site in 1994. The plant has been operated by Kaiser-Hill Company Incorporated since July 1, 1995.

#### **3 1 3 RFETS Operations**

Prior to 1992, production activities included fabrication of nuclear weapons components from beryllium, plutonium, stainless steel, and uranium, assembly of components, and chemical recovery and purification of recyclable transuranic radionuclides. Other activities included research and development in metallurgy, machining, nondestructive testing, coatings, remote engineering, chemistry, and physics. The major classes of waste generated include hazardous waste, radioactive waste, and mixed (hazardous and radioactive) waste. Currently, the mission at RFETS is decontaminating, decommissioning, and environmental restoration.

Figure 3 1  
RFETS Site Location Map



## **3 2 THE MOUND SITE (IHSS 113)**

### **3 2 1 The Mound Site Location**

The Mound Site is located north of Central Avenue, and east of the protected area (PA) fence. For the purpose of this HASP, the Mound Site will be broken down into two areas, the excavation and the Contaminated Soil Feed Stockpile (CSFS) which is located approximately 600 feet to the east of the Mound Site proper. Maps of the site are illustrated in Figures 3 2, 3 3, and 3 4.

### **3 2 2 The Mound Site Background**

Between 1954 and 1958 approximately 1,405 drums were placed at the Mound Site and covered with soil, thus generating a mound. The drums contained uranium and beryllium contaminated lathe coolant (a mixture of approximately 70 percent hydraulic oil and 30 percent carbon tetrachloride), tetrachloroethylene (PCE), and trichloroethylene. Historic information also indicates that some of the coolant contained plutonium.

In 1970 all drums were removed from the Mound Site along with some radiologically contaminated soil. Approximately 10 percent of the drums were thought to have leaked at the time of removal. Solid material was shipped offsite for disposal and liquids were sent to Building 774 for processing. No airborne radiological contamination was detected during the drum removal. Soil from the excavation was graded and the excess was placed in the landfill.

As a result of the past activities numerous subsurface soil and groundwater characterization studies have been conducted at the Mound Site. These characterizations included the drilling of 22 boreholes, a soil gas vapor survey, and the installation of seven groundwater monitoring wells. The data from these investigations indicate levels of volatile organic compounds (VOCs), primarily tetrachloroethylene, in the soil at levels requiring cleanup.

# Mound Site Excavation Map

Figure 3.3

### EXPLANATION

- ~ Contours 2' intervals
- ~ IHSS
- ~ Central Avenue Ditch
- Groundwater Well Locations  
Note: Well 174 is abandoned
- ▲ Burial Site Location
- Area to be excavated
- HW Incidental water  
holding tank
- PW Dust Suppression  
water holding tank
- EZ/SCA Excavation Zone/Shell  
Construction Area
- CSC Contaminated Reduction Zone
- RAA Radiological Buffer Areas

### Standard Map Features

- - - Fences
- - - Paved roads
- - - Dirt roads



Scale = 1:225  
1 inch represents 55 feet



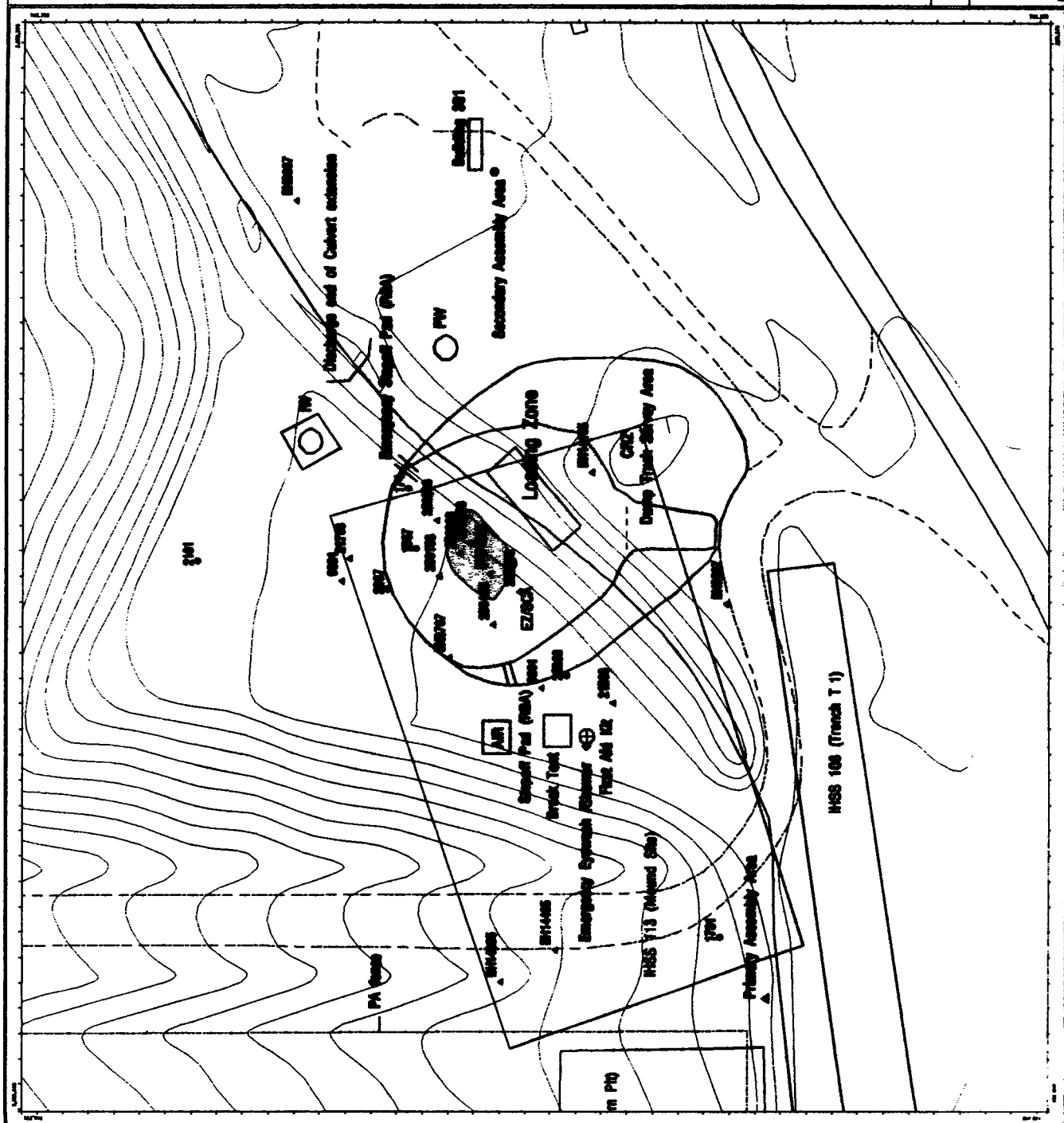
See Page 100 for Project  
Location Map

U.S. Department of Energy  
Rocky Flats Environmental Technology Site



Rocky Flats  
Environmental Technology Site  
U.S. Department of Energy  
Rocky Flats Environmental Technology Site  
U.S. Department of Energy

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# Mound Site Source Removal Map

Figure 3.2

**EXPLANATION**  
Contours (5 intervals)

1100

1100

**Standard Map Features**  
Fence

Proposed road

Dirt road

Map shows  
contours and features provided by  
Rocky Mountain Remediation, LLC  
on 10/27/95. Contours are  
100' intervals. Contours are  
100' intervals.

North Arrow

Scale 1" = 1000'  
1 inch represents 110 feet

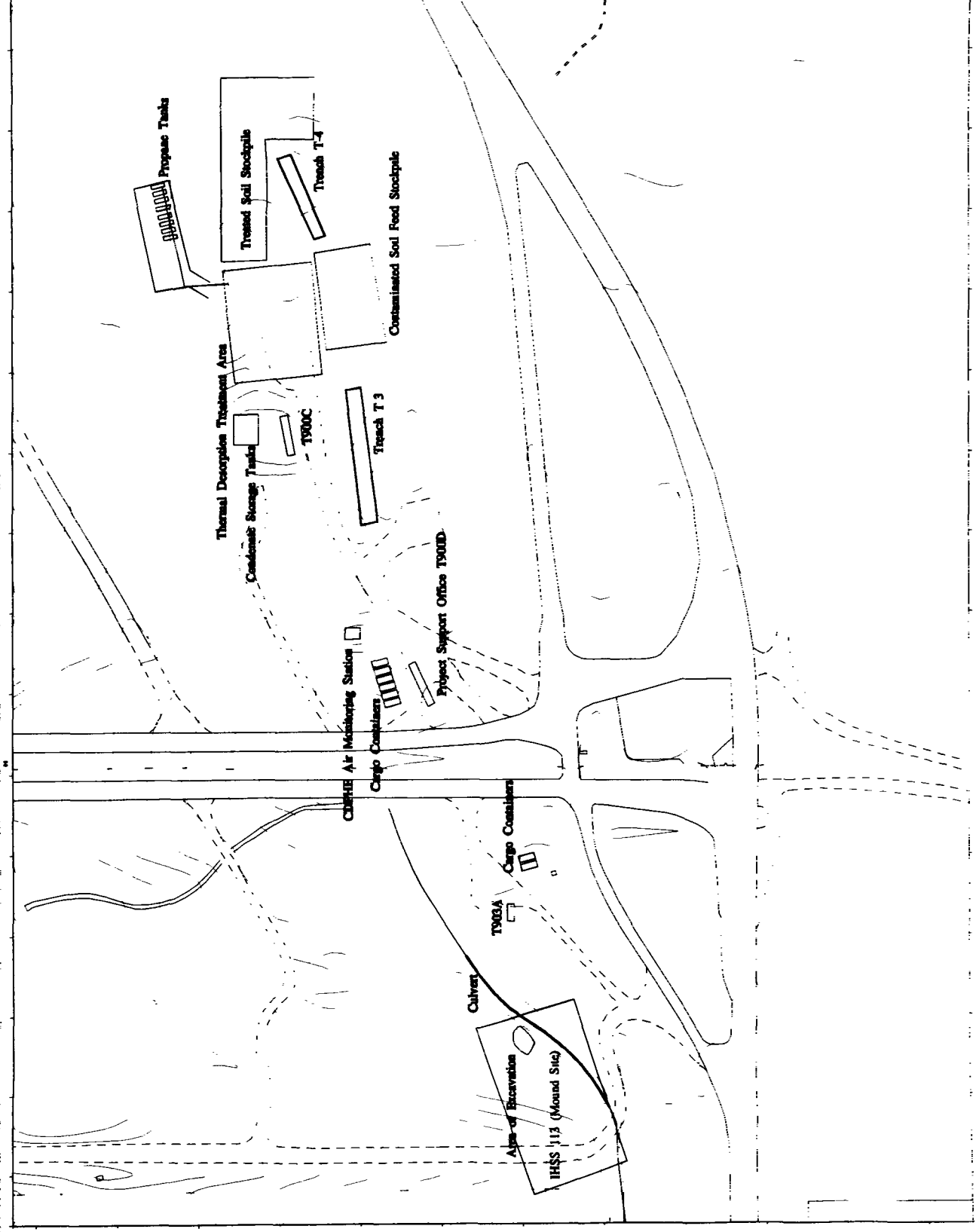
State Plane Coordinate Projection  
Colorado Central Zone  
Datum: NAD83

U.S. Department of Energy  
Rocky Flats Environmental Technology Site

Rocky Mountain  
Remediation, LLC  
10000 North  
Rocky Flats  
Boulder, CO 80501

Map ID: 87-005

February 26, 1997



## **4 0 SCOPE OF WORK**

The scope of work will involve site preparation and subsequent excavation of approximately 400 to 1,000 cubic yards of contaminated soil using standard excavation equipment. The soil will be transported to and temporarily stockpiled in the CSFS, located approximately 600 feet east of the Mound Site (Figure 3 2). The CSFS is just south of where the thermal desorption treatment equipment will be mobilized to process the soil. After excavation is completed, contaminated soil will be treated using a low temperature thermal desorption remediation technology and stockpiled in the treated soil stockpile area. Treated soil, upon confirmed attainment of performance goals, will be backfilled into the excavation. Reclamation of the stockpile, treatment, and excavation area will be performed to return these areas to improved natural conditions. The following is a breakdown of the tasks to be implemented during the source removal at the Mound Site. A task-specific hazard analysis is included in Section 5 5 and task specific Activity Hazard Analyses are included in Appendix B.

### **4 1 TASK 1 - SITE PREPARATION**

Most of the site preparation will involve the installation of a culvert in the Central Avenue drainage ditch and the subsequent backfilling of the ditch to provide a loading area during excavation of the Mound Site. The remainder of the work will consist of minor road improvements, and establishing work zones and equipment infrastructure at both the excavation and the CSFS areas.

The culvert installation, minor road improvements, and establishing equipment infrastructure are included in this HASP for overall project continuity although the work does not involve radiological or chemical hazards. Work will be performed in accordance with all portions of this HASP with the exception of the portions which address chemical and radiological hazards.

Tasks to be completed during the installation of the culvert and conducting minor road improvements will include:

- Installing approximately two hundred feet of 30" culvert in the bottom of the Central Avenue drainage ditch. This will require excavating approximately one foot of the bottom of the ditch to attain proper grade for the culvert. Excavated soil will be placed on the northeast side of the mound excavation area to control incidental runoff and runoff during excavation of the Mound Site,
- Backfilling the Central Avenue drainage ditch to provide a loading area during excavation of the Mound Site. Backfilling the Central Avenue drainage ditch will require the removal of vegetative soil, scarifying the surface, compacting the fill material, and the use of a nuclear soil density gauge to evaluate compaction, and
- Conducting minor road improvements along Central Avenue including the placement of road base, compacting and grading.

Tasks to be completed during the establishment of equipment infrastructure at both the excavation and the CSFS include

- Constructing secondary containments to hold poly tanks that will receive stormwater from either the Mound Site excavation or the plastic lined stormwater ditch surrounding the CSFS,
- Staging poly tanks, pumps, generators, supplied air trailers and other miscellaneous equipment,
- Driving fence posts, ground rods, and equipment hold downs,
- Moving and setting up jersey barriers,
- Setting up exclusion zones (EZ) which for radiological purposes will be the soil contamination areas (SCA), contamination reduction zones (CRZ) which will also contain the radiological buffer area (RBA) including the stepoff pad, project support zones, and general site control zones, and
- Mobilizing heavy equipment

Activities required to support the culvert installation, minor road improvements, and establishment of equipment infrastructure will include the following

- Operating heavy equipment and industrial fork trucks,
- Wearing appropriate personal protective equipment,
- Monitoring personnel for noise and heat/cold stress exposure,
- Monitoring wind speed,
- Controlling traffic when conducting minor road improvements along the edge of Central Avenue,
- Spraying water to minimize dust,
- Spraying ConCover® to stabilize the berm on the northeast side of the Mound Site, and
- Securing the work area at the end of each day

#### **4 2 TASK 2 - INSTALLING STORMWATER DITCH AND REMOVING TOPSOIL AT CSFS**

This task involves the installation of a plastic lined stormwater collection ditch and grading the topsoil at the CSFS in preparation for stockpiling contaminated soil from the Mound Site excavation. Activities required to complete this task include the following

- Working under the stipulations of a Radiological Work Permit
- Operating heavy equipment,
- Wearing appropriate personal protective equipment,
- Performing CSFS EZ/SCA work area high volume radiological air monitoring,
- Performing support zone perimeter low volume radiological air monitoring,
- Performing radiological surveys on soils, and equipment,
- Frisking personnel for radiological purposes,
- Monitoring personnel for noise and heat/cold stress exposure,
- Monitoring wind speed,



- Spraying water to minimize dust
- Decontaminating equipment,
- Performing personnel contamination control,
- Managing waste such as disposable personal protective equipment, and
- Securing the CSFS at the end of each day

#### **4 3 TASK 3 - EXCAVATION OF CONTAMINATED SOIL**

This task includes excavating approximately 400 to 1,000 cubic yards of contaminated soil. A track mounted excavator (trackhoe) will be used to excavate the soil. The contaminated soil will be placed in a forty ton articulated dump truck and transported to the CSFS. Excavation activities will continue until excavation verification samples indicate that soils equal to or above the VOC cleanup target levels described in the PAM have been removed or the limiting conditions in the PAM have been encountered. Activities required to accomplish the excavation of contaminated soil include the following:

- Working under the stipulations of a Radiological Work Permit
- Operating the excavator
- Wearing appropriate personal protective equipment,
- Performing excavation EZ/SCA perimeter high volume radiological air monitoring,
- Performing support zone perimeter low volume radiological air monitoring,
- Performing radiological surveys on soils, and equipment
- Frisking personnel for radiological purposes
- Conducting real-time air monitoring for VOCs and particulates,
- Conducting personal integrated air sampling for VOCs
- Monitoring personnel for noise and heat/cold stress exposure
- Monitoring wind speed,
- Spraying water to minimize dust,
- Pumping incidental stormwater from the excavation,
- Decontaminating equipment,
- Performing personnel contamination control,
- Managing waste such as disposable personal protective equipment, and
- Securing the excavation at the end of each day and during the treatment of contaminated soil

#### **4 4 TASK 4 - TRANSPORT AND DUMPING OF CONTAMINATED SOIL**

This task involves the use of a forty ton articulated dump truck to transport contaminated soil from the excavation to the CSFS. To ensure safe movement of the truck, a Traffic Management Plan has been prepared and resides in the Field Implementation Plan (FIP). In addition, the Site Safety Officer will escort every load of soil to ensure prompt response to any spills and to monitor for VOCs and particulates. The forty ton articulated truck will be dumped in a manner which limits tire contact with

contaminated soil    Activities required to accomplish the transport and dumping of contaminated soil include the following

- Working under the stipulations of a Radiological Work Permit
- Operating the forty ton dump truck,
- Posting the dump truck as an SCA
- Wearing appropriate personal protective equipment,
- Closing the northernmost lane of the East Access Road,
- Positioning flagpersons on the two north-south roads to control traffic during truck movement,
- Spraying water when loading and prior to transport to minimize dust,
- Escorting the dump truck to ensure prompt response should a spill or dust generation occur,
- Performing CSFS EZ/SCA perimeter high volume radiological air monitoring,
- Performing support zone perimeter low volume radiological air monitoring,
- Performing radiological surveys on soils, and equipment,
- Frisking personnel for radiological purposes,
- Conducting real time air monitoring for VOCs and particulates,
- Conducting personal integrated air sampling for VOCs,
- Monitoring personnel for noise and heat/cold stress exposure,
- Spraying water when dumping soil to minimize dust,
- Decontaminating equipment,
- Performing personnel contamination control, and
- Managing waste such as disposable personal protective equipment

#### **4 5    TASK 5 - MANAGEMENT OF CONTAMINATED SOIL FEED STOCKPILE**

This task involves the management of the contaminated soil at the CSFS    To facilitate efficient loading of the CSFS, a front end loader will be utilized    Management of the CSFS also includes the pumping of incidental water from the stormwater collection system and covering the CSFS with a water-resistant tarpaulin at the end of the shift    Activities required to accomplish the loading and management of the CSFS include the following

- Working under the stipulations of a Radiological Work Permit
- Operating the front end loader,
- Wearing appropriate personal protective equipment,
- Performing CSFS EZ/SCA perimeter high volume radiological air monitoring,
- Performing support zone perimeter low volume radiological air monitoring,
- Performing radiological surveys on soils, and equipment,
- Frisking personnel for radiological purposes,
- Conducting real-time air monitoring for VOCs and particulates,
- Conducting personal integrated air sampling for VOCs,

- Monitoring personnel for noise and heat/cold stress exposure,
- Spraying water when dumping and moving soil to minimize dust,
- Covering the CSFS with a water-resistant tarpaulin
- Pumping incidental water from the stormwater collection system,
- Decontaminating equipment,
- Performing personnel contamination control,
- Managing waste such as disposable personal protective equipment, and
- Securing the CSFS at the end of each day

#### **4 6 TASK 6 - EXCAVATION VERIFICATION SAMPLING**

Excavation verification samples will be used to establish the post-action condition of the soils at the boundaries of the excavation. Samples will be collected and analyzed for the VOC contaminants of concern as described in the Sampling and Analysis Plan. Since the existing characterization data indicates that metals and semi-volatile contaminants are below cleanup levels in the trenches, no further soil sampling will be done for those constituents. Activities required to accomplish this sampling include the following:

- Working under the stipulations of a Radiological Work Permit
- Operating the excavator,
- Wearing appropriate personal protective equipment,
- Performing excavation EZ/SCA perimeter high volume radiological air monitoring,
- Performing support zone perimeter low volume radiological air monitoring,
- Performing radiological surveys on soils, and equipment,
- Frisking personnel for radiological purposes,
- Conducting real-time air monitoring for VOCs, and particulates,
- Conducting personal integrated air sampling for VOCs,
- Monitoring personnel for noise and heat/cold stress exposure,
- Decontaminating the excavator bucket
- Sampling from the excavator bucket,
- Decontaminating sampling equipment,
- Performing personnel contamination control,
- Managing waste such as disposable personal protective equipment and sampling equipment, and
- Packaging the samples for shipment,

#### **4 7 TASK 7 - DECONTAMINATION OF EQUIPMENT**

All materials and equipment in contact with soils will require decontamination prior to release from the EZ/SCA at either the excavation or CSFS and prior to free release from RFETS to off site locations. Decontamination methods will vary depending on the location and extent of contamination and

effectiveness will be determined by visual inspection, radiological surveys and volatile organic compound monitoring. At the discretion of the Project Manager, items may be decontaminated in the field or transferred to the Main Decontamination Facility. Activities required to decontaminate heavy equipment and materials include the following:

- Working under the stipulations of a Radiological Work Permit
- Staging heavy equipment,
- Wearing appropriate personal protective equipment,
- Performing excavation or CSFS EZ/SCA perimeter high volume radiological air monitoring,
- Performing excavation or CSFS support zone perimeter low volume radiological air monitoring,
- Performing radiological surveys on equipment,
- Frisking personnel for radiological purposes,
- Conducting real-time air monitoring for VOCs and particulates,
- Conducting personal integrated air sampling for VOCs if necessary,
- Monitoring personnel for noise and heat stress exposure,
- Establishing a portable decontamination station with secondary containment,
- Transferring items to the Main Decontamination Facility,
- Spraying water at low or high pressures,
- Wiping or scrubbing,
- Performing personnel contamination control, and
- Managing waste such as disposable personal protective equipment and decontamination fluids

#### **4.8 TASK 8 – SOIL TREATMENT**

Soil will be treated using a low vacuum low temperature thermal desorption system (TDU) operated by a treatment subcontractor. The TDU will be assembled and operated in the TDU area as shown in Figure 3.2. The TDU is a batch treatment system that is capable of desorbing contaminants under a non-oxidative atmosphere and low temperature such that the desorbed contaminants do not degrade and generate thermal or oxidative by-products. The CSFS is located proximal to the TDU site allowing short staging time prior to treatment in the TDUs. Operation of the TDU system will be addressed in an additional Health and Safety Plan which will be prepared by the treatment subcontractor and approved by the RMRS Project Manager, RMRS Radiological Coordinator, RMRS Health and Safety Supervisor, RMRS Radiological Safety Section Manager, and SSOC Radiological Engineering.

#### **4.9 TASK 9 - POST TREATMENT VERIFICATION SAMPLING**

Post treatment verification samples will be taken by the treatment subcontractor to verify compliance with treatment standards. Samples will be collected and analyzed for the VOC contaminants of concern as described in the SAP. Since the existing characterization data indicates that metals and semi-volatile contaminants are below cleanup levels, no further soil sampling will be done for those constituents. Post

treatment verification sampling will also be addressed in the Health and Safety Plan prepared by the treatment subcontractor

#### **4 10 TASK 10 - TRANSPORT AND BACKFILL OF TREATED SOIL**

This task involves the loading of conventional dump trucks with front end loaders to transport soil from the treated soil stockpile to the excavation. To ensure safe movement of the trucks, a Traffic Management Plan has been prepared and resides in the FIP. In addition, the Site Safety Officer will escort every load of soil to ensure prompt response to any spills. Activities required to accomplish the transport of treated soil include the following:

- Working under the stipulations of a Radiological Work Permit
- Operating the front end loader and dump trucks
- Posting the dump trucks as SCAs
- Wearing appropriate personal protective equipment
- Performing excavation or CSFS EZ/SCA perimeter high volume radiological air monitoring,
- Performing excavation or CSFS support zone perimeter low volume radiological air monitoring,
- Performing radiological surveys on equipment,
- Frisking personnel for radiological purposes,
- Conducting real-time air monitoring for VOCs and particulates,
- Monitoring personnel for noise and heat stress exposure,
- Spraying water when loading and prior to transport to minimize dust,
- Escorting the dump truck to ensure prompt response should a spill or dust generation occur,
- Closing the northernmost lane of the East Access Road,
- Positioning flagpersons on the north-south road to control traffic during truck movement,
- Spraying water when dumping and moving soil to minimize dust, and
- Performing personnel contamination control

#### **4 11 TASK 11 - DECONTAMINATION OF EQUIPMENT**

This task will be identical to the previous decontamination task except that no VOC contaminated soil will be present and respiratory protection must comply with the RWP for any radiological concerns that may be present when decontaminating.

## **4 12 TASK 12 - SITE RECLAMATION**

Once treated soils are returned to the excavation site, topsoil will be returned to both the excavation and CSFS areas. The topsoil will be graded and the areas will be revegetated with an appropriate seed mixture in order to return them to improved natural condition. The seed mixture will be covered to prevent wind dispersal and promote germination. Fencing, fence posts, and other material or equipment will then be removed.

- Working under the stipulations of a Radiological Work Permit
- Operating heavy equipment,
- Wearing appropriate personal protective equipment,
- Performing excavation and CSFS EZ/SCA work area high volume radiological air monitoring,
- Performing excavation and CSFS support zone perimeter low volume radiological air monitoring,
- Performing radiological surveys on materials, and equipment;
- Frisking personnel for radiological purposes,
- Monitoring personnel for noise and heat/cold stress exposure,
- Monitoring wind speed,
- Spraying water to minimize dust,
- Decontaminating equipment;
- Performing personnel contamination control,
- Managing waste such as disposable personal protective equipment,
- Performing field instrument for the detection of low energy radiation (FIDLER) surveys of treatment and excavation areas, and
- Securing the excavation and CSFS at the end of each day

## **5 0 HAZARD ASSESSMENT**

The hazards associated with operations at the Mound Site include hazardous substances (chemical and radiological), biological hazards and physical hazards

### **5 1 CHEMICAL HAZARDS**

Based on site history and analytical sample results as summarized in the PAM, chemical of concern (COCs) have been identified at the Mound Site. Table 5.1 presents the physical and chemical characteristics for the COCs. The Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs) and the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs) will be used to evaluate potential exposure to the COCs. When presented, the PELs and TLVs are the most recent published values. MSDSs for chemical products used on site are included in Appendix C.

The primary exposure pathway for the COCs is the inhalation of vapors or contaminated dust particles. The second exposure pathway is skin or eye contact or absorption. The majority of the COCs are VOCs at normal ambient temperatures and will volatilize into the breathing zone. The COCs could also become airborne in the breathing zone as a result of contaminated dust. Air monitoring will be conducted to locate, control, and reduce the potential for exposure (monitoring requirements are presented in Section 7.3). Dust suppression techniques such as water spraying and careful soil handling shall be used to reduce potential exposures to contaminated airborne dust. The use of level B personal protective equipment will be used to prevent inhalation and skin or eye contact with the COCs. Personnel may be exposed to accidental ingestion of contaminants by hand to mouth transfer after contact with contaminated materials. Ingestion of contaminants will be controlled on the site by specific prohibitions, work practices, and requirements for decontamination. Potential collocated worker exposures will be controlled by continuous EZ/SCA perimeter air monitoring for VOCs and particulates.

#### **5.1.1 Volatile Organic Compounds (VOCs)**

The volatile organic compounds of concern are, Carbon Tetrachloride, Methylene Chloride, Tetrachloroethylene (PCE), and Trichloroethylene (TCE). The maximum VOC concentrations in soil or groundwater at the Mound Site are shown in Table 5.2. The primary exposure route of these VOCs is inhalation of vapors.

Table 5 1  
Physical and Chemical Characteristics of Chemicals of Concern

Contaminant (Synonyms) (Abbreviations)	Action Level	OSHA PELs or ACGIH TLVs	OSHA IDLH	Physical/Chemical Characteristics	Routes of Exposure	First Aid	Exposure Symptoms
Carbon Tetrachloride (Tetrachloromethane) CAS# 56-23 5	2.5 ppm Skin	5 ppm-TWA 10 ppm-STEL 25 ppm-C (200 ppm 5 min max peak in any 4 hrs)	Carcinogen 200 ppm	Colorless liquid with a characteristic ether-like odor Noncombustible liquid MW 153.8 BP 170°F Sol. 0.05% Fl P: NA LEL NA IP 11.47eV	Inhalation Ingestion Absorption Contact	Artificial respiration Seek medical attention, Irrigate and wash area affected immediately	CNS depression, nausea and vomiting, liver and kidney damage, skin and eye irritation, drowsiness, dizziness, incoordination
Methylene Chloride (Dichloromethane) (Methylene Dichloride) CAS# 75-09 2	25 ppm	50 ppm-TWA 1000 ppm-C (2000 ppm 5 min max peak in any 2 hrs)	Carcinogen 2300 ppm	Colorless liquid with chloroform-like odor Combustible liquid MW 84.9 BP 104°F Sol 2.0% Fl P ? IP 11.32eV	Inhalation Ingestion Contact Absorption	Artificial respiration, Seek medical attention, Irrigate and wash area affected immediately	Fatigue, weakness, sleepiness, lightheadedness, numbness and tingling in limbs, nausea, skin and eye irritation
Tetrachloroethylene (Perchloroethylene) (Tetrachlorobenzene) (Percl) (PCE) CAS# 127 18-4	12 ppm	25 ppm-TWA 100 ppm-STEL 200 ppm-C (300 ppm 5 min max peak in any 3 hrs)	Carcinogen 150 ppm	Colorless liquid with a mild chloroform-like odor Noncombustible liquid MW 165.8 BP 250°F Sol 0.02% Fl P NA IP 9.32eV	Inhalation Ingestion Absorption Contact	Artificial respiration Seek medical attention Irrigate and wash area affected immediately	Eye, Nose, throat irritation, nausea, flush face and neck, vertigo, dizziness, incoordination, headache, sleepiness, skin erythema, liver damage
Trichloroethylene (Ethylene Trichloride) (Trichloroethene) (TCE) CAS# 79-01-6	25 ppm	50 ppm-TWA 100 ppm-STEL 200 ppm-C (300 ppm 5 min max peak in any 2 hrs)	Carcinogen 1 000 ppm	Colorless liquid with a chloroform-like odor Combustible liquid MW 131.4 BP 189°F Sol 0.0001% Fl P ? IP 9.45eV	Inhalation Ingestion Absorption Contact	Artificial respiration, Seek medical attention, Irrigate and wash area affected immediately	Headache, vertigo, visual disturbance, fatigue, giddiness, tremor, sleepiness, vomiting, nausea, dermatitis, cardiac arrhythmias, parathesia, eye and skin irritation, liver damage



**Table 5 1 (Continued)**  
**Physical and Chemical Characteristics of Chemicals of Concern**

**Key**

ACGIH	American Conference of Governmental Industrial Hygienists
BP	Boiling point
C	Ceiling Concentration shall not be exceeded at any time
CNS	Central nervous system
Fl pt	Flash point the temperature at which the liquid phase gives off enough vapor to flash when exposed to an external ignition source Closed cup unless otherwise noted
FRZ	Freezing point for liquids and gases °F
IDLH	Immediately Dangerous to Life and Health Maximum concentration from which one could escape within 30 minutes without experiencing any irreversible health effects
IP	Ionization potential eV (electron volts)
LEL	Lower explosive (flammable) limit in air % by volume
mg/m <sup>3</sup>	milligrams per cubic meter
MW	Molecular weight
NA	Not applicable
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Limit Concentration is a time weighted average that must not be exceeded during any 8 hour workshift of a 40-hour workweek (OSHA)
PPM	Parts per million
Skin	Potential significant contribution to the overall exposure by the cutaneous route including mucous membranes and the eyes either by contact with vapors or of probable greater significance by direct skin contact with the substance
Sol	Solubility in water at 68°F % by weight
Sp Gr	Specific gravity at 68°F referenced to water at 39.2 °F
STEL	Short Term Exposure Limit A 15 minute average concentration which should not be exceeded at any time during a workday Exposure over the PEL or TLV up to the STEL should be no longer than 15 minutes and should not occur more than four times per day There should be at least 60 minutes between successive exposures in this range
TLV	Threshold Limit Value Concentration that nearly all workers may be repeatedly exposed day after day without adverse effect (Based on an 8 hour workday and 40-hour workweek) (ACGIH)
UEL	Upper explosive (flammable) limit in air % by volume
VP	Vapor pressure at 68°F in millimeters (mm) mercury (Hg) unless otherwise noted

**References**

Air Contaminants Permissible Exposure Limits (29 CFR 1910.1000)

American Conference of Governmental Industrial Hygienists Threshold Limit Values and Biological Exposure Indices for 1995 to 1996

National Institute of Occupational Safety and Health Pocket Guide to Chemical Hazards June 1994

**Table 5.2**  
**Maximum Concentrations of Volatile Organic Compounds**  
**in**  
**Soil or Water**

<b>Chemical Name</b>	<b>Concentration (ppm)</b>	<b>Location</b>
Carbon Tetrachloride	0.005	Soil Borehole 14495
Methylene Chloride	19.0	Soil Borehole 14295
Tetrachloroethylene	760.0	Soil Borehole 14295
Trichloroethylene	18.0	Groundwater Well 0174

### **5.1.2 Semi-Volatile Organic Compounds (SVOCs)**

Semi-volatile organic compounds have been detected at low concentrations in subsurface soil samples at the Mound Site. Based on the low concentrations and low vapor pressures, inhalation of vapors is not a probable route of exposure. The exposure risk from inhaling contaminated dust particles is low and will be further reduced through dust suppression, air monitoring, and respiratory protection. Finally, ingestion, contact, and absorption exposures are also considered low and will be greatly reduced through effective work practices, personal protective clothing, decontamination, and good personal hygiene. After careful evaluation, there are no semi-volatile compounds which are a chemical of concern.

### **5.1.3 Polycyclic Aromatic Hydrocarbons (PAHs)**

Polycyclic aromatic hydrocarbon compounds have been detected at low concentrations in subsurface soil samples at the Mound Site. Inhalation of vapors is not a probable route of exposure due to the low concentrations and low vapor pressures. As with SVOCs, the exposure risk from inhaling contaminated dust particles is low and will be further reduced through dust suppression, air monitoring, and respiratory protection. Ingestion, contact, and absorption exposures are also considered low and will be greatly reduced through effective work practices, personal protective clothing, decontamination, and good personal hygiene. After careful evaluation, there are no polycyclic aromatic hydrocarbon compounds which are a chemical of concern.

#### **5 1 4 Polychlorinated Biphenyls (PCBs)**

Polychlorinated biphenyls, formerly used as a component in hydraulic fluid, have been detected in subsurface soil samples at the Mound Site at concentrations up to 5 2 ppm They are potent liver toxins and have low acute toxicity but can accumulate in fatty tissue leading to delayed health effects Exposure to PCB s may occur through ingestion, contact, or absorption if workers are in direct contact with soil or materials containing PCBs Ingestion, contact, and absorption exposures are considered low and will be greatly reduced through effective work practices, personal protective clothing, decontamination, and good personal hygiene Due to the low vapor pressure of PCBs inhalation of vapors is not a probable route of exposure Inhalation of PCBs bound to dust particles is possible, but the exposure risk is low and will be further reduced through the dust suppression and respiratory protection After careful evaluation, there are no polychlorinated biphenyl compounds which are a chemical of concern

#### **5 1 5 Metals**

Various metals have been detected in subsurface soil samples at the Mound Site Based on the concentrations detected, the potential of exposure is low and does not warrant a possible risk for exceeding action levels

The radioactive metals Americium, Plutonium, and Uranium were evaluated for chemical toxicity hazards as well as radioactive toxicity hazards For each of these metals, the radiological hazard is greater than the chemical toxicity hazard The controls in place to limit radiological exposure are more protective than controls that would be established to ensure protection from the chemical toxicity hazards presented by Americium, Plutonium, and Uranium

### **5 2 RADIOLOGICAL HAZARDS**

Based on analytical sample results as summarized in the PAM, above-background concentrations of Americium-241, Plutonium-239/240, Uranium-233/234, Uranium-235, and Uranium-238 have been identified in subsurface soils at the Mound Site The physical and chemical characteristics of the radionuclides are presented in Table 5 3 Maximum concentration of radionuclides detected in the soil at the Mound Site are listed in Table 5 4

Radiological hazards, including potential collocated worker exposure, associated with the Mound Site will be controlled by the use of a RWP, real time contamination detection instruments, perimeter high volume air monitoring, vicinity low volume air monitoring, dust suppression, bioassay, and external dosimetry The radiological hazards can be broken down into two distinct categories external radiation exposure and internal radiation exposure Based on process history knowledge and characterization data at the Mound Site the total expected exposure to workers is less than 5mrem

Table 5 3  
 Physical and Chemical Characteristics of Radionuclides of Concern

Contaminant (Synonyms) (Abbreviations)	OSHA PELs or ACGIH TLVs <sup>1</sup>	OSHA IDLH <sup>1</sup>	Physical/Chemical Characteristics	Routes of Exposure	First Aid	Exposure Symptoms
Americium 241 (Am-241)	5 rem/yr 2 X 10 <sup>-12</sup> uCi/ml DAC <sup>2</sup>	Carcinogen	Silvery somewhat malleable radioactive metal	Inhalation Ingestion Absorption Contact	Follow directions of on-site Radiological Personnel	No acute symptoms from low level exposures
Plutonium 239/240	5 rem/yr 2 X 10 <sup>-12</sup> uCi/ml DAC	Carcinogen	Silvery radioactive metal	Inhalation Ingestion Absorption Contact	Follow directions of on-site Radiological Personnel	No acute symptoms from low level exposures
Uranium 233/234	5 rem/yr 2 X 10 <sup>-12</sup> uCi/ml DAC 0.05 mg/m <sup>3</sup> -TWA 0.06 mg/m <sup>3</sup> -C	Carcinogen 10 mg/m <sup>3</sup>	Silvery radioactive metal	Inhalation Ingestion Absorption Contact	Follow directions of on-site Radiological Personnel	No acute symptoms from low level exposures
Uranium 235	5 rem/yr 2 X 10 <sup>-12</sup> uCi/ml DAC 0.05 mg/m <sup>3</sup> -TWA 0.06 mg/m <sup>3</sup> -C	Carcinogen 10 mg/m <sup>3</sup>	Silvery radioactive metal	Inhalation Ingestion Absorption Contact	Follow directions of on-site Radiological Personnel	No acute symptoms from low level exposures
Uranium 238	5 rem/yr 2 X 10 <sup>-12</sup> uCi/ml DAC 0.05 mg/m <sup>3</sup> -TWA 0.06 mg/m <sup>3</sup> -C	Carcinogen 10 mg/m <sup>3</sup>	Silvery radioactive metal	Inhalation Ingestion Absorption Contact	Follow directions of on-site Radiological Personnel Decontamination will be performed per ROI-2 03	No acute symptoms from low level exposures

<sup>1</sup> mg/m<sup>3</sup> are for chemical properties  
<sup>2</sup> DAC Derived Air Concentration

**Table 5 4**  
**Maximum Concentrations of Radionuclides**  
**in Soil**

<b>Radionuclide</b>	<b>Concentration (pCi/g)</b>	<b>Location</b>
Americium - 241	0 3572	Soil Borehole 14295
Plutonium - 239/240	1 905	Soil Borehole 14295
Uranium - 233/234	18 41	Soil Borehole 14295
Uranium - 235	1 376	Soil Borehole 14295
Uranium - 238	101 1	Soil Borehole 14295

### **5 2 1 External Radiation Exposure**

Beta and gamma radiations are emitted by the radionuclides which are present in the soils at the Mound Site. However, the hazard associated with the level of beta radiation in the Mound Site soils is minimal. External beta radiation cannot penetrate beyond the shallow layers of the skin or the lens of the eye, and so associated hazards are confined to these areas. Eye and skin exposure to external beta radiation is greatly reduced or eliminated through the use of eye protection and personal protective clothing.

External gamma radiation, unlike beta radiation, readily penetrates deep into the body and is therefore hazardous to internal organs. However, the hazard associated with the level of gamma radiation in the Mound Site soils is minimal. Clothing and eye protection are not effective at reducing external gamma radiation exposure. Four accepted methods to minimize gamma exposures are:

- The use of shielding between personnel and the radiation source,
- Minimizing time in the radiation area,
- Maximizing distance from the radiation source, and
- Reducing or minimizing the source of radiation.

Due to low levels of gamma radiation, external shielding designed to reduce gamma radiation exposure

will not be necessary for workers at the Mound Site. Should external radiation be of concern, the most effective methods of reducing worker exposure to external gamma radiation will be by posting areas where elevated gamma exposure rates exist and limiting the amount of time workers spend in these areas. Work assignments will be evaluated to ensure that personnel are maintaining a maximum possible distance from radiation sources.

### **5.2.2 Internal Radiation Exposure**

Alpha radiation is the primary radiation hazard which may be present at the Mound Site. Alpha radiation, due to its relatively large mass and charge, does not pose an external hazard and will not penetrate the outer layer of dead skin cells. However, alpha radiation is a significant internal hazard due to the large amount of energy deposited in small, localized areas of internal organs. Alpha radiation is principally admitted to the body by inhalation of airborne contamination but ingestion, injection, and absorption of surface contamination through the skin are also possible. Radioactive contamination existing in the form of loose material is capable of migrating or being transported by a variety of mechanisms such as movement of personnel, vehicles, equipment, and wind.

Air particulates that are suspended or have settled out on horizontal surfaces (equipment) and have been resuspended pose an inhalation hazard. Drinking contaminated water, eating contaminated food, and/or transferring contamination to the mouth pose an ingestion hazard. Abrasions, lacerations, or punctures of the skin resulting from contact with contaminated surfaces pose an injection hazard. Absorption hazards exist when radioactive isotopes are chemically incorporated in a substance that is able to permeate the skin.

Exposure to radioactive contamination and the potential for internal contamination will be controlled by the proper use and removal of PPE, administrative controls in radiological controlled areas including prohibitions against smoking, eating, drinking and chewing, and proper use of respirators when airborne contamination above prescribed limits is suspected.

### **5.3 BIOLOGICAL HAZARDS**

During field work at this site, personnel may encounter a wide variety of insects including bees, wasps, mosquitoes, and spiders.

Stings of bees and wasps may cause serious allergic reactions in certain individuals. Personnel with known insect allergies or sensitivities should notify the SSO before field work begins. Ticks are parasites that feed on the blood of an animal/human host and can carry several severe diseases, the least severe bringing several days of fever and pain and the worst causing brain damage. Poisonous snakes or spiders may also be encountered at the site. Personnel should visually check before reaching into a covered area and walking through grassy areas. If a person is stung/bitten by a bee, wasp, snake, or spider, call

extension 2911, notify the Site Safety Officer or Field Supervisor, and immediately transport the person to the RFETS medical center

## 5 4 PHYSICAL HAZARDS

The following sections discuss physical hazards and the measures to be taken to control the hazards

### 5 4 1 Heavy Equipment Hazards

The operation of heavy equipment poses a hazard to personnel, equipment, and property Control measures for the safe operation of heavy equipment will include

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- Heavy equipment from off site vendors will be inspected by Skip Chandler, RMRS Health and Safety, or his designee prior to entering RFETS
- Hoisting equipment from off site vendors will be inspected by Skip Chandler RMRS Health and Safety, or his designee prior to entering RFETS,
- On site heavy equipment will be inspected by Skip Chandler RMRS Health and Safety or his designee prior to entering the Mound Site
- Heavy equipment will have rollover protection systems
- Operators will be properly trained in the use and limitations of the specific pieces of heavy equipment being operated,
- Heavy equipment will be inspected by the operator prior to the beginning of each shift and an inspection checklist will be completed

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- Seat belts will be worn by heavy equipment operators at all times,
- Establishing heavy equipment roadways and operating areas
- Ground personnel will wear orange reflective vests and hard hats when heavy equipment is in use,
- Personnel will remain at least twenty feet from all heavy equipment while they are in operation and maintain line of site with the operator,
- When sampling or obtaining FIDLER readings at the excavator or front end loader buckets the operator will set the bucket on the ground, disengage the hydraulic system, set the parking brake, and give a hand signal indicating that ground personnel may approach,
- At no time will any personnel position themselves under hydraulically operated equipment or loads and
- The backing up of all heavy equipment will require a spotter to ensure that the path of travel is clear

## **5 4 2 Excavation Hazards**

Excavations pose a hazard due to cave-ins, slips, trips, falls, and underground utilities Measures used to control these hazards include

- The preparation and approval of Soil Disturbance Permits which address overhead and underground utility hazards,
- The excavation will be inspected by a competent person prior to each shift, during each shift, and immediately after any rain or snow storms or other hazard increasing occurrences,
- Heavy equipment entry into the excavation will not be permitted,
- The excavator will be operated in accordance with the manufacturers recommendations in regards to safe operating distances from the excavation,
- At no time will the counterweight on the excavator be positioned above the open excavation,
- A spotter will be present during all excavation activities,
- Personnel entry into the excavation will not be permitted,
- Personnel will stay a minimum of six feet away from the edge of the excavation,
- Personnel closer than six feet to the excavation must wear a full body harness and lifeline attached to an approved anchorage point, and
- Equipment, except the excavator, will be kept a minimum of six feet away from the edge of the excavation

## **5 4.3 Noise Exposure Hazards**

Work at the site will expose personnel to high noise levels from the operation of heavy equipment and hand tools Excessive noise exposure can cause both temporary and permanent effects on hearing The temporary effects of excessive noise include ringing in the ears, interference with communication, and hearing threshold changes The effect of long-term excessive noise includes varying degrees of noise-induced hearing loss Measures used to control noise exposure hazards will include

- Noise monitoring to determine employee exposure,
- Hearing protection for exposures of greater than 85 dBA for any length of time,
- Noise monitoring to confirm the effectiveness of the hearing protection worn, and
- Noise dosimetry to determine employee exposure and whether participation in the Hearing Conservation Program is required The Hearing Conservation Program includes both training and audiometric testing



#### **5 4 4 Heat and Cold Stress Hazards**

During operations there is a potential for worker exposure to serious temperature extremes. These environmental conditions increase the risk of heat or cold stress during field activities. Measures used to control heat stress exposure will include:

- Briefing employees on the causes, prevention, signs/symptoms, and treatment of heat stress
- Monitoring for exposure to heat stress using a Wet Bulb Globe Thermometer (WBGT),
- Proper monitoring of employee physiology including heart rate and oral temperature,
- Wearing ice vests or other RMRS approved measures,
- Instituting a work-rest regimen based on the KH Heat Stress Program (see Appendix D), and
- Providing personnel with a shaded break area and cool liquids

Measures used to control cold stress exposure will include:

- Briefing employees on the causes, prevention, signs/symptoms and treatment of cold stress
- Monitoring for exposure to cold stress using a dry bulb thermometer and anemometer,
- Wearing adequate insulating dry clothing when the air speed and temperature result in an equivalent chill temperature of  $< 40^{\circ}\text{F}$ ,
- Changing wet clothing,
- Instituting a work-warming regimen based on the ACGIH guidelines (see Appendix D) when the equivalent chill temperature is  $< 19.4^{\circ}$ ,
- Providing personnel with a heated break area and warm sweet drinks, and
- Taking special precautions when handling evaporative liquids such as gasoline at equivalent chill temperatures  $< 39.2^{\circ}\text{F}$

#### **5 4 5 Personal Protective Equipment (PPE) Hazards**

PPE will be required for most activities placing a physical and mental strain on the wearer. When PPE such as SCBAs, airline respirators, gloves, shoe covers, and protective anti-C coveralls are worn, visibility, hearing, manual dexterity, and communications are impaired. Additionally, the risk of heat stress increases. Measures used to control these hazards will include:

- PPE will be inspected prior to use,
- Keeping the work area clear of trip hazards through diligent housekeeping,
- Providing radios for communication,
- Developing hand signals for communication. Personnel will be briefed on hand signals during the Level B respirator training session, and
- Monitoring for and preventing heat stress as described above

#### **5 4 6 Overhead Power Line Hazards**

Special precautions must be taken when working or operating heavy equipment in the vicinity of overhead electrical power lines. Contact with electrical power lines can cause shock, burns, or death. Measures used to control overhead power line hazards will include:

- Assume all overhead lines are energized,
- Heavy equipment will be operated with a 10' minimum clearance between the power lines and any part of the equipment, and
- Strictly adhering to RFETS Health and Safety Practices Manual (HSP) HSP-2 08, "Lock Out/Tag Out" when conducting lock out/tag out operations on overhead lines

#### **5 4 7 Vehicular Traffic Hazards**

Employees will exhibit special caution when working along active roadways. Measures used to control traffic hazards will include:

- Wearing orange vests,
- Positioning flagpersons along active roadways to control traffic,
- Closing roads as needed,
- Placing jersey barriers around regularly occupied work areas

#### **5 4 8 Portable Electric Generator Hazards**

Due to a lack of permanently installed electrical power, portable electric generators will be used extensively during the project. Generators will be used to power portable hand tools, pumps, and the perimeter radiological air samplers. Measures used to control the hazards associated with the use of generators will include:

- Extension cords will be intended for outdoor use, inspected by the user, and protected from unnecessary damage,
- Any extension cords which show signs of damage or deterioration will be immediately removed from service,
- Generators will be equipped with GFCI outlets which will be tested daily by the user,
- Generators will be properly grounded via a ground rod,
- A 10 lb ABC fire extinguisher will be located next to all generators,
- Refueling will be conducted at the beginning of the shift when the generators are cool, and
- Refueling will be conducted with the generator on the ground surface or with the generator grounded to the fuel dispenser

The RFETS Lock Out/Tag Out Program (HSP 2 08) will be strictly adhered to during the servicing and maintenance of machines or equipment in which the unexpected energization or start up of the machine or equipment, or release of stored energy could cause injury to personnel.

#### 5 4 9 Hand Tool Hazards

The improper use of hand tools can result in injury to personnel and damage to property Measures used to protect personnel and equipment will include

- Hand tools will be inspected by the user prior to use
- Hand tools will be used for their intended use and operated in accordance with HSP-12 10,
- Guards will be in place and no modifications will be made,
- Portable power tools will be plugged into GFCI protected outlets, and
- Portable power tools will be UL listed and have a three wire grounded plug or be double insulated

#### 5 4 10 Compressed Gas Hazards

Compressed gas cylinders and systems pose a hazard to personnel and property due to unknown contents, misuse and rupture The use of compressed gas cylinders and systems during the project will be those associated with the supplied airline respirators and SCBA systems Measures used to control the use of compressed gas cylinders and systems will include

- Obtaining certification papers with all breathing air or other compressed gas shipments,
- Ensuring that all cylinders and systems are properly labeled,
- The air trailer attendant will inspect cylinders and systems prior to and during each shift,
- Heavy equipment operators will inspect heavy equipment mounted airline bottles prior to and during each shift,
- Securing cylinders in the upright position, and
- Properly tightening all fittings and connections

#### 5 4 11 Hoisting and Rigging Equipment Hazards

Hoisting and rigging equipment poses a unique hazard due to sudden failure Measures used to control the use of hoisting and rigging equipment will include

- Hoisting equipment from off site vendors will be inspected by Skip Chandler, RMRS Health and Safety, or his designee prior to entering RFETS,
- Operators will be properly trained in the use and limitations of the specific pieces of hoisting equipment being operated,

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- Hoisting equipment will be inspected by the operator prior to the beginning of each shift and an inspection checklist will be completed,
- Rigging equipment will be inspected by the user prior to use on a daily basis,
- Any rigging equipment which show signs of damage or deterioration will be immediately removed from service,
- Ensuring that all rigging equipment is properly positioned,
- At no time will any personnel position themselves under hoisted loads, and
- Ground personnel will wear orange vests and maintain line of site with the operator

#### **5 4 12 Fork Truck Hazards**

The operation of fork trucks pose a hazard to personnel, equipment, and property Control measures for the safe operation of fork trucks will include

- Fork truck operators will hold a current Fork Truck Operator Permit,
- Fork trucks will be inspected by the operator prior to the beginning of each shift and an inspection checklist will be completed,
- Ground personnel will wear orange vests and maintain line of site with the operator, and
- All loads will be secured

#### **5 4 13 Ladder Hazards**

Work on ladders poses a hazard due to falls and ladder failure Control measures for the use of ladders will include

- Ladder users will have current Ladder Safety Awareness training,
- Ladders will be Type 1-A, Industrial Extra Heavy Duty or better;
- Aluminum ladders will not be used in areas where there is electrical power equipment,
- Three legged ladders are strictly prohibited,
- Ladders will be inspected by the user prior to use on a daily basis,
- Ladders which show signs of damage or deterioration will be immediately removed from service
- Ladders will be used for their intended purpose, and
- Work on ladders at heights greater than six feet will require evaluation from the SSO

#### **5 4 14 Elevated Work Hazards**

Unprotected elevated work at heights greater than six feet poses a hazard due to the potential for falls Prior to wearing fall arrest equipment, attempts will be made to eliminate the hazard If, however the hazard cannot be eliminated and fall arrest equipment must be worn, the following control measures will be followed

- Personnel shall have current Fall Protection qualification,
- Fall arrest equipment will be inspected by the user prior to use on a daily basis,
- Fall arrest equipment which show signs of damage or deterioration will be immediately removed from service, and
- The fall arrest system will consist of a full body harness, shock absorbing lanyard, and an approved anchorage point

#### **5 4 15 Flammable or Combustible Liquid Storage Hazards**

Hazards associated with improper flammable or combustible liquid storage include fires and spills Work controls involved with flammable or combustible liquid storage include

- Containers will be metal safety cans in good repair,
- Containers will be equipped with spring loaded closing devices and flame arresters,
- Containers will be properly labeled, and
- Container will be stored in approved flammable storage cabinets when not in use

#### **5 4 16 ConCover® Machine Hazards**

During site preparation and at various times during the project a soil stabilizing product known as ConCover® will be applied Hazards associated with the ConCover® machine include inhalation of silica during the mixing of the two part solution, contact with rotating internal parts, exposure to high pressure liquids, and falling from the unit while in transport Control measures for the use of the ConCover® machine include

- At a minimum a full-facepiece air-purifying respirator with HEPA cartridges will be worn,
- Personnel will not reach into the machine during the mixing of the solution,
- At no time will the nozzle be pointed at any body part or other personnel, and
- Operators will ride only in the approved area while in transport and the restraint device(s) will be in place

#### **5 4 17 High Temperature, High Pressure Decontamination System Hazards**

Should the use of a high temperature, high pressure decontamination system be required in the field personnel will have current Pressure Safety II training and the following control measures will be implemented

- Personnel will be briefed on the use of the system,
- The wand, trigger mechanism, hoses, and temperature/pressure generating unit will be inspected by the user prior to use

- At no time will the wand be pointed at any body part or other personnel, and
- Polycoated Tyvek®, 16" high steel toed rubber boots, safety glasses, hard hat with face shield, and inner and outer nitrile gloves will be worn at a minimum

## 5.5 TASK BY TASK HAZARD ANALYSIS

Table 5.5 presents a task by task hazard analysis for each location based on the hazards listed in the above sections. The hazard evaluation for each activity is based on the following criteria:

- Low – activities are likely to result in no exposure to chemical, radiological, or biological hazards. Physical hazards are minimal.
- Moderate – activities could possibly result in chemical, radiological, or biological exposures below established exposure limits. Physical hazards exist but are controlled through effective work practices.
- High – activities could possibly result in chemical, radiological, or biological exposures near or above established exposure limits. Physical hazards exist and exposure to the hazard is not controlled.

**Table 5.5**  
**Task by Task Hazard Analysis**

Tasks	Biological	Chemical	Physical	Radiological
Site Preparation	Low	Low	Moderate	Low
Stormwater Ditch and Topsoil at CSFS	Low	Low	Moderate	Moderate
Excavate Contaminated Soil	Low	High	Moderate	Moderate
Transport Contaminated Soils	Low	Moderate	Moderate	Moderate
Manage Contaminated Soil Feed Stockpile	Low	High	Moderate	Moderate
Trench Verification Sampling	Low	Moderate	Moderate	Moderate
Decontaminate Equipment	Low	Moderate	Moderate	Moderate
Transport and Backfill Treated Soil	Low	Low	Moderate	Moderate
Decontaminate Equipment	Low	Low	Moderate	Moderate
Site Reclamation	Low	Low	Moderate	Low

## **6 0 GENERAL HEALTH AND SAFETY REQUIREMENTS**

All on-site employees are required to obtain clearance from the RMRS Project Manager, or the RMRS Health and Safety Supervisor before beginning work at this site. Training requirements for specific individuals will depend on the tasks to be performed and associated hazards or risks, and safety requirements.

### **6 1 MEDICAL SURVEILLANCE**

All personnel assigned to field activities must participate in RFETS Medical Surveillance Program, in accordance with 29 CFR 1926.65 (f) and HSP Section 4.0, with subsequent certification by an occupational physician for physical fitness, the ability to perform hazardous waste work, nuclear work, and wear both an air purifying and a supplied air respirator. Radiation dosimeters and bioassay testing will be furnished by RFETS as necessary for personnel working on this project.

The RMRS Health and Safety Supervisor will review medical documentation from the physician to ensure fitness for duty. Any restrictions will be noted and adhered to.

### **6 2 SAFETY TRAINING**

Employees will not participate in field activities until they have been trained to a level required by their job function and responsibility. All training and field experience will be verified and records shall be maintained by the Site Safety Officer in the Mound Site Health and Safety office located in trailer T900D. Training requirements are summarized in Table 6.1 and must be current. An X means the training is required.

**Table 6 1**  
**Safety Training Summary**

Required Training	EZ/SCA and CRZ/RBA Personnel	Project Support Zone Personnel
General Employee Radiation Training (#019-278-01) <sup>2</sup>	X	X
Haz Com Work Area Indoctrination (#019-750-03) <sup>2</sup>	X	X
Lock Out/Tag Out Briefing (#019-866-02)	X	X
OSHA 40 - Hour (#018-691-03)	X	X
OSHA 8 - Hour (#018-691-05)	X	X
OSHA Supervisor (#018-691-01)	X <sup>1</sup>	X <sup>1</sup>
OSHA 3 - Day On Site Supervision (#018-691-07)	X	X
Pre-Evolution Briefing <sup>2</sup>	X	X
Radiation Worker II (#023-482-01)	X	
Respirator Indoctrination (#056-284-01)	X	
Respirator Fit Chamber Certification (#056-284-02)	X	
HSP-21 04 CBT (#047-115-00) or Briefing <sup>2</sup>	X	X
Supplied Air Respirator Indoctrination	X	
<sup>1</sup> For supervisors and foremen <sup>2</sup> For personnel involved in the culvert installation and site preparation		



### 6 3 SITE-SPECIFIC SAFETY BRIEFING

A site specific Hazard Communication briefing will be conducted for all employees, including subcontractors, prior to commencement of field activities. The following topics will be discussed at this briefing

- Names of health and safety personnel and alternates responsible for site health and safety,
- Health and safety organization,
- Hazards at the site including chemical, radiological, physical, and biological,
- Location and review of MSDSs for all hazardous chemicals on site,
- Exposure risk,
- Personal protective equipment to be used,
- Personnel and equipment decontamination procedures,
- Air monitoring for radionuclides and chemicals of concern, and
- Emergency procedures

If an off site vendor is used to perform parts of this project then the following items will also be discussed

- Employee rights and responsibilities and location of DOE form F5480 4, "Complaint Form"
- General subcontractor, lower-tier subcontractor and/or vendor responsibilities,
- Location of the approved Health and Safety Plan,
- First aid and medical facilities,
- Emergency response procedures including local warning and evacuation systems,
- Specific occupational health and safety procedures applicable to the project,
- The Hazard Communications Program,
- Employee access to exposure monitoring data and medical records,
- Construction hazard recognition and the procedures for reporting or correcting unsafe conditions,
- Procedures for reporting accidents or incidents,
- Fire prevention and control,
- Alcohol and drug abuse policy, and
- Disciplinary actions for safety infractions and violations

It is the employees responsibility to ensure he/she is familiar with the HASP contents relating to their specific job tasks. If at anytime, an employee does not feel they understand the contents of the HASP, another briefing shall be administered. Once the briefing is completed and employees understand the contents of the HASP, they will be required to sign the Safety Compliance Agreement form acknowledging they understand and agree to comply with this HASP.

If a new employee who has not gone through the site-specific safety orientation meeting is assigned to the site, the SSO must provide a similar briefing to the new employee before he or she participates in any field activities. New employees must sign the Safety Compliance Agreement form and meet the training requirements of Section 6.2 before beginning field work for this project.

#### 6.4 DAILY/SHIFT HEALTH AND SAFETY MEETINGS

Daily/shift plan-of-the-day (POD) and safety briefings for site employees will be conducted. The briefings will address the day's planned activities, reminders of safety responsibilities, new chemicals brought on site, and any safety concerns. These meetings will be documented by the Site Safety Officer.

#### 6.5 ACCIDENT/INCIDENT REPORTING

All accidents, incidents, and near misses will be immediately reported to the Field Supervisor and the Project Manager. It is the Project Manager's responsibility to ensure that the appropriate personnel are notified of the accident/incident. In addition, RFETS requires Department of Energy (DOE) form 5484 X, "Individual Accident/Injury Report" to be completed for all first aid incidents and the following:

"Recordable" occupational injuries or illnesses as defined below:

- **OCCUPATIONAL INJURY** is any injury such as a cut, fracture, sprain, or amputation that results from a work accident or from an exposure involving a single incident in the work environment that requires more than standard first aid.

Note: Conditions resulting from animal or insect bites, or one-time exposure to chemicals, are considered to be injuries.

- **OCCUPATIONAL ILLNESS** of an employee is any abnormal condition or disorder, other than one resulting from an occupational injury, caused by exposure to environmental factors associated with employment. It includes acute and chronic illnesses or diseases that may be caused by inhalation, absorption, ingestion, or direct contact with a toxic material.
- **PROPERTY DAMAGE LOSSES** of \$1,000 or more are reported as follows: Accidents that cause damage to DOE property, regardless of fault, or accident wherein DOE may be liable for damage to a second party, are reportable if damage is \$1,000 or more. Include damage to facilities, inventories, equipment, and properly parked motor vehicles. Exclude damage resulting from a DOE-reportable vehicle accident.
- **GOVERNMENT MOTOR VEHICLE ACCIDENTS** resulting in damages of \$250 or more, or involving injury, are reported unless the government vehicle is not at fault, damage of less than

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\$250 is sustained by the government vehicle, and no injury is inflicted on the government vehicle occupants

## **6 6 VISITOR CLEARANCES**

Visitors to the work site will be given a site specific safety orientation by the Site Safety Officer or Field Supervisor as described in Section 6 3 Prior to entering the EZ/SCA or CRZ/RBA, visitors will provide the Site Safety Officer with documentation of training required by Section 6 2 All visitors who do not provide documentation will not be allowed in the EZ/SCA or CRZ/RBA Visitors without the training required in Section 6 2 must be escorted in the project support zone by a trained individual

## **6 7 HEALTH AND SAFETY LOGBOOK**

Separate health and safety logbooks shall be maintained by the SSO, HSS, and RCT s and turned in to the Project Manager once the project is completed The Project Manager will then turn in the project logbooks and documents to the environmental records management group Logged information will meet the requirements of RFETS Conduct of Operations Manual, COOP-006, Operating Area Logs and Records and shall include (1) summary of daily health and safety issues, (2) all measurements taken, (3) types of monitoring conducted, (4) description of unforeseen hazards and steps taken to mitigate hazards, (5) safety infractions, (6) accidents and injuries, and (7) other significant health and safety items

## 7 0 SITE-SPECIFIC HEALTH AND SAFETY REQUIREMENTS

### 7 1 SITE CONTROL

Site control is necessary to prevent unauthorized, untrained, or unprotected personnel or visitors from being exposed to the hazards associated with the site. During activities at the Mound Site, site control measures will include the following:

- All personnel and visitors are required to enter their name, time in, and time out on the sign in sheet located at the access control point in the Project Support Zone,
- Adhering to the personnel roster requirements on the Radiological Work Permit,
- Posting signage communicating information such as required personal protective equipment, work zone boundaries, and radiological hazards,
- Securing all work areas at the end of each shift,
- Cones will be placed six feet back from the edge of the excavation to warn personnel of the edge of the excavation, and
- Erecting a fence around the excavation during the treatment phase of the project

### 7 2 WORK ZONES

The excavation and the CSFS will be divided into three basic zones:

- 1 Exclusion Zone (EZ) - For radiological purposes, the exclusion zone boundary will also be the Soil Contamination Area boundary (SCA)
- 2 Contamination Reduction Zone (CRZ) - For radiological purposes the CRZ will contain the Radiological Buffer Area (RBA) which will include the stepoff pad, and
- 3 the Project Support Zone

The EZ/SCA includes areas of physical, chemical, or radiological hazards. The EZ/SCA will be clearly marked with banner tape, fencing or other high visibility markings, and signs. Only authorized personnel are permitted within the EZ/SCA. The EZ/SCA will be the areas around the excavation and the CSFS where all soil will be handled. Mandatory training and the use of personal protective equipment will be required for entry into the EZ/SCA. NOTE: The boundaries and locations of the EZ/SCA are subject to change should the health or safety of collocated workers, the public, or the environment be in question.

The Contamination Reduction Zone CRZ/RBA is the corridor through which all personnel and equipment will enter and exit from the EZ/SCA. Entrances and exits shall be clearly marked with high visibility items such as traffic cones, banner tape or other high visibility markings, and signs. The CRZ/RBA contains decontamination equipment and containers for disposable personal protective equipment, etc. All personnel radiological frisking will occur in the CRZ/RBA at the stepoff pad. NOTE: To ensure that the health and safety of collocated workers and the public is not in question, the boundaries and locations of the EZ/SCA and CRZ/RBA are subject to change based on air monitoring results and potential

Field Change No 2

Field Change No 2

exposure to chemical radiological or safety hazards

The Project Support Zone contains personnel who perform support functions and a provides break area Managers support equipment, etc are generally located in the project support zone Personnel and equipment exiting the EZ/SCA must be decontaminated within the CRZ/RBA prior the entering the project support zone

### 7 3 PERSONAL PROTECTIVE EQUIPMENT (PPE)

The purpose of personal protective equipment (PPE) including clothing is to shield or isolate individuals from the chemical, radiological, physical and biological hazards that they may encounter at sites containing hazardous or toxic materials The careful selection and use of PPE will protect the respiratory system skin, eyes face, hands, feet head, body, and hearing

No single combination of protective equipment and clothing is capable of protecting against all hazards and PPE must be used in conjunction with other protective methods The use of PPE can in itself create significant worker hazards such as heat stress physical and psychological stress, and impaired vision, mobility and communication

Specific protective garments are selected on the basis of a variety of criteria In general, the greater the hazard the greater the level of PPE For any given situation, equipment and clothing must be selected to provide an adequate level of protection Over-protection as well as under-protection can be hazardous and should be avoided

Table 7 1 summarizes PPE requirements for specific tasks associated with operations at the Mound Site Non-routine miscellaneous subtask PPE requirements are addressed in Table 7 2 The following sections detail the criteria for selecting specific PPE which will apply to this project NOTE The PPE shown in Tables 7 1 and 7 2 are subject to change at the discretion of the Site Safety Officer and the Radiological Engineer PPE worn will be that which is more restrictive for chemical or radiological hazards

**Table 7 1**  
**Task Specific**  
**Personal Protective Equipment Summary**

Task	Level	Body <sup>1</sup>	Feet	Head	Eye <sup>2</sup>	Hand	Respirator
Site Preparation	D	Work clothes	Steel toed safety shoes	Hard hat	Safety glasses with side shields	Heavy duty leather gloves	None required FF APR when mixing ConCover®
Installing Stormwater Ditch and Grading Topsoil at the CSFS	Modified D	Anti-C Tyvek®	Steel toe safety shoes and shoe covers	Hard hat	Safety glasses with side shields	Inner surgeon and outer nitrile gloves or inner gloves and heavy duty leather work gloves (cotton liners optional)	None required
Excavation of Contaminated Soil	B	Anti-C Tyvek®	Steel toe safety shoes and shoe covers	Hard hat	None	Inner surgeon and outer nitrile gloves (cotton liners optional)	Supplied air or SCBA
Transport of Contaminated Soil	B	Anti-C Tyvek®	Steel toe safety shoes and shoe covers	Hard hat	None	Inner surgeon and outer nitrile gloves (cotton liners optional)	Supplied air or SCBA
Management of CSFS	B	Anti-C Tyvek®	Steel toe safety shoes and shoe covers	Hard hat	None	Inner surgeon and outer nitrile gloves (cotton liners optional)	Supplied air or SCBA
Excavation Verification Sampling	B	Anti-C Tyvek®	Steel toe safety shoes and shoe covers	Hard hat	None	Inner surgeon and outer nitrile gloves (cotton liners optional)	Supplied air or SCBA
Decontamination of Equipment <sup>3</sup>	B <sup>3</sup>	Anti-C Tyvek®	Steel toe safety shoes and shoe covers	Hard hat	None <sup>4</sup>	Inner surgeon and outer nitrile gloves (cotton liners optional)	Supplied air or SCBA
Transport and Backfill of Treated Soil	Modified D <sup>3</sup>	Anti-C Tyvek®	Steel toe safety shoes and shoe covers	Hard hat	Safety glasses with side shields	Inner surgeon and outer nitrile gloves (cotton liners optional)	None required
Decontamination of Equipment <sup>3</sup>	Modified D <sup>3</sup>	Anti-C Tyvek®	Steel toe safety shoes and shoe covers	Hard hat	Safety glasses with side shields	Inner surgeon and outer nitrile gloves (cotton liners optional)	None required
Site Reclamation	Modified D <sup>3</sup>	Anti-C Tyvek®	Steel toe safety shoes and shoe covers	Hard hat	Safety glasses with face shield	Inner surgeon and outer nitrile gloves or inner gloves and heavy duty leather work gloves (cotton liners optional)	None required

<sup>1</sup> If splash hazards exists and cannot be mitigated polycoated Tyvek® will be worn

<sup>2</sup> No eye protection will be required when a full facepiece respirator is worn

<sup>3</sup> Work may be conducted without respiratory protection if continuous real time air monitoring indicates no volatile organic compounds at levels above background and the RWP does not require respirators for radiological purposes

<sup>4</sup> If no respiratory protection is required safety glasses with side shields will be worn

<sup>5</sup> If high pressure water is used 16 high steel toed rubber boots will be worn If no respiratory protection is required and high pressure water is used a hard hat mounted face shield will be worn in addition to the safety glasses

**Table 7 2**  
**Miscellaneous Subtasks**  
**Personal Protective Equipment Summary**

Task	Level	Body	Foot	Head	Eye <sup>1</sup>	Hand	Respirator
Mixing ConCover®	C	Tyvek®	Steel toed safety shoes	Hard hat	None required	Inner surgeon gloves and heavy duty leather work gloves	Full facepiece air purifying with HEPA cartridge
Pumping incidental waters or decontamination liquids into holding tanks or tanker trucks PPE is for personnel in the support zone PPE in the EZ/SCA will be that required for the task being performed	Modified D	Long sleeve cotton coveralls with neoprene apron	Steel toed safety shoes	Hard hat with face shield	Safety glasses with side shields	Outer nitrile gloves or inner surgeon gloves with heavy duty leather gloves	Based on breathing zone air monitoring
Frisking personnel or equipment at the stepoff pad located in the CRZ/RBA	Modified D	Long sleeve cotton coveralls	Steel toed safety shoes	Hard hat	Safety glasses with side shields	Inner surgeon gloves	None required
Conducting radiological or industrial hygiene air monitoring in the CRZ/RBA	Modified D	Long sleeve cotton coveralls	Steel toed safety shoes	Hard hat	Safety glasses with side shields	None required	None required
Refueling Heavy Equipment at the EZ/SCA Boundary	Modified D <sup>2</sup>	Anti-C Tyvek®	Steel toed safety shoes and shoe covers	Hard hat	Safety glasses with side shields	Outer nitrile gloves or inner surgeon gloves with heavy duty leather gloves	None required
Refilling Heavy Equipment Airline Bottles at the EZ/SCA Boundary	Modified D <sup>2</sup>	Anti C Tyvek®	Steel toe safety shoes and shoe covers	Hard hat	Safety glasses with side shields	Outer nitrile gloves or inner surgeon gloves with heavy duty leather gloves	None required
General Heavy Equipment Maintenance at the EZ/SCA Boundary	Modified D <sup>2</sup>	Anti-C Tyvek®	Steel toe safety shoes and shoe covers	Hard hat	Safety glasses with side shields	Outer nitrile gloves or inner surgeon gloves with heavy duty leather gloves	None required

<sup>1</sup> No eye protection will be required when a full facepiece respirator is worn

<sup>2</sup> Modified level D PPE will be allowed if all of the following conditions are met

- 1 Continuous real time air monitoring indicates no volatile organic compounds at levels above background
- 2 No excavating is taking place
- 3 Personnel stay as close to the equipment as possible No wandering
- 4 Radiological control technicians are present

### **7 3 1 Level D Personal Protective Equipment**

The use of Level D personal protective equipment is defined by the following criteria

- No contaminants are present, or contaminants are present below the action levels established in the HASP for respirator use, and
- Work functions preclude splashes, immersion, or potential for unexpected inhalation of any chemicals or radionuclides

Level D is a field work uniform affording minimal skin protection and no respiratory protection It consists of the following PPE

- Steel toe safety shoes (ANSI Z41 1 approved),
- Heavy duty leather work gloves,
- Safety glasses (ANSI Z87 1 approved) with side shields, and
- Hard hat (ANSI Z89 1 approved)

Modified Level D personal protective equipment provides an increased level of skin protection and no respiratory protection It consists of the following PPE

- Steel toe safety shoes,
- leather work gloves,
- Safety glasses with side shields,
- Hard hat,
- Anti-C Tyvek® coveralls or long sleeved cotton coveralls,
- Outer nitrile gloves or inner surgeon gloves and heavy duty leather work gloves, and
- Disposable shoe covers

### **7 3 2 Level C Personal Protective Equipment**

The main selection criterion for Level C, as opposed to the less restrictive Level D, is that conditions require and permit wearing air-purifying respirators A full-face, air-purifying respirator can be used only if all of the following conditions are met

- Oxygen concentrations are greater than 19.5 percent and less than 23.5 percent by volume,
- Measured air concentrations of identified substances will be reduced by the respirator below the PEL or TLV,
- Atmospheric contaminant concentrations do not exceed IDLH levels,
- Continuous direct readings on monitoring instruments, such as FIDs or PIDs, are within



the action levels prescribed in the HASP for air-purifying respirator use,

- The substance in question has adequate warning properties,
- The individual has taken the Respirator Indoctrination CBT class,
- The individual has passed a mask specific quantitative fit-test,
- The individual has medical clearance for the use of air-purifying respirators, and
- The appropriate cartridge is used and its service limit concentration is not exceeded

Level C personal protective equipment provides moderate skin and respiratory protection It consists of the following PPE

- Full-facepiece, air-purifying respirator with correct cartridges,
- Steel toe safety shoes
- Hard hat
- Anti-C Tyvek® coveralls
- Inner surgeon and outer nitrile gloves, and
- Disposable shoe covers

### 7 3 3 Level B Personal Protective Equipment

In cases where air-purifying respirators do not provide adequate respiratory protection, Level B PPE will be worn Criterion for selection of Level B PPE are as follows

- Measured air concentrations of identified substances will be reduced by the supplied air respirator or self contained breathing apparatus (SCBA) below the PEL or TLV,
- Continuous direct readings on monitoring instruments, such as FIDs or PIDs, are within the action levels prescribed in the HASP for supplied air respirator use
- The individual has taken the Level B Respirator Indoctrination class,
- The individual has passed a mask specific quantitative fit-test, and
- The individual has medical clearance for the use of supplied air respirators

Level B PPE provides moderate skin protection and the maximum respiratory protection It consists of the following PPE

- Full-facepiece, supplied air respirator or SCBA,
- Steel toe safety shoes,
- Hard hat,
- Anti-C Tyvek® coveralls,
- Inner surgeon and outer nitrile gloves and
- Disposable shoe covers

#### **7.3 4 Storage, Inspection, and Maintenance of PPE**

Clothing and respirators must be properly stored to prevent damage and/or malfunction due to exposure to dust, sunlight, damaging chemicals, and impact. Proper storage of PPE and respirators will include the following:

- Clothing and respirators will be stored in a dry, clean, uncontaminated area out of direct sunlight,
- Clothing and respirators will not be stored in proximity to any chemicals such as gasoline;
- Clothing will be stacked in orderly fashion so that no other objects or equipment are on top of them leading to tears, punctures, rips, or deformations,
- All SCBAs and airline respirators will be properly placed in their cases,
- All full-facepiece air-purifying respirators will be stored in a single layer with no other objects or equipment placed on top of them which could lead to deformation of the facepiece, and
- Different types and materials of clothing should be clearly marked or stored separately to prevent issuing the wrong clothing by mistake

Inspection of clothing and respirators (SCBAs, airline, and full-facepiece air-purifying) is imperative to ensure proper protection. It is the responsibility of each individual to thoroughly inspect all clothing and respirators prior to and during field activities. Inspection of clothing will include the following:

- Visually inspecting for imperfect seams, non-uniform coatings, tears, and malfunctioning closures,
- Holding clothing up to light and inspecting for pinholes,
- Flexing the products to inspect for cracks and other signs of shelf deterioration,
- Inspect gloves for pinholes by blowing into the them, sealing the gauntlet, and observing for air leakage,
- While in the field, periodically inspect for tears, punctures, and closure failures, and
- After use, inspect for signs of degradation, permeation, or other signs of deterioration

Inspection of SCBAs and airline respirators will be performed prior to each use and will include:

- Visually inspect the air cylinder, backpack, harnesses, high and low pressure hoses, and regulators,
- Visually inspect the facepiece assembly,
- Inspect all connections for proper tightness,
- Conduct a leak test,
- Conduct the audio alarm test, and
- Conduct a unit function test in both normal operating mode and in the emergency bypass mode

Inspection of full-facepiece air-purifying respirators will be performed prior to each use and will include

- Visually inspect the facepiece seal lens, and harness,
- Inspect the inhalation and exhalation valves,
- Inspect cartridges for proper type and expiration date, and
- Conduct both positive and negative pressure tests

Maintenance of all PPE and SCBAs or airline respirators will be performed only by individuals having specialized training and equipment

### **7 3 5 PPE Donning and Doffing Guidelines**

The following guidelines are required when Level C PPE or higher is required for a task No person shall be allowed to enter the EZ/SCA or CRZ/RBA if they are not wearing the appropriate PPE Donning and doffing guidelines will be posted at the appropriate location at both the excavation and the CSFS

#### **Donning Guidelines**

After inspecting supplied air respirators and SCBA systems PPE will be donned in the following order

- 1 Cotton glove liners
- 2 Shoe covers
- 3 Anti-C Tyvek® coveralls
- 4 Rubber overshoes
- 5 Skull cap
- 6 Respiratory protection, as required
- 7 Hood, as required
- 8 Gloves
- 9 Tape up wrists and ankle seams tab tape for easy removal
- 10 Thermoluminescent dosimeters (TLDs) should be worn outside the Anti-C Tyvek® coveralls
- 11 Attach facepiece to air line or self-contained breathing apparatus (level B)

## Doffing Guidelines

After completion of gross decontamination and washing and rinsing shoe covers and gloves, it is recommended that PPE be removed in the following order

- 1 Remove exposed tape
- 2 Remove rubber overshoes
- 3 Remove outer gloves
- 4 Remove hood from front to rear
- 5 Remove respirator protection, as applicable
- 6 Remove Anti-C Tyvek® coveralls, inside out, touching inside only
- 7 Remove each shoe cover, placing shoe onto clean stepoff pad
- 8 Remove inner gloves and cloth liners as applicable
- 9 Commence whole body frisking per RFETS Radiological Operating Instructions Manual (ROI), ROI-2 01, "Personal Contamination Monitoring "
- 10 Monitor dosimeter, and equipment
- 11 Wash hands and face
- 12 Clean and sanitize respirator after receiving radiological clearance from RCTs

Disposable PPE will be discarded in the properly labeled container and handled in accordance with RFETS Field Operations Manual (FO), FO 06, "Handling of Personal Protective Equipment " Decontamination for Modified Level D, Level C and Level B will be per Section 7 4

## 7 4 MONITORING REQUIREMENTS

Monitoring of the environmental conditions in and around the excavation and the CSFS must occur because of the potential for contaminants to be present The following sections describe the monitoring program to be implemented and appropriate exposure limits and actions levels Where feasible, personnel exposures to hazardous materials (other than radioactive substances) shall be maintained within the TLVs adopted by the ACGIH or the PELs adopted by OSHA, whichever is more stringent Exposure to radioactive material will be maintained as low as reasonably achievable (ALARA) and below the RFETS administrative control limit of 750 mrem Table 7 3 presents a summary of the monitoring program

**Table 7 3**  
**Monitoring Program Summary**

Field Change No 1

<b>RADIATION</b>			
<b>Hazard</b>	<b>Action Level</b>	<b>Action(s) to be Taken</b>	<b>Monitoring Frequency</b>
Equipment and material contamination	Alpha contamination >20 dpm/100cm <sup>2</sup> removable >100 dpm/100cm <sup>2</sup> total Not to exceed >300 dpm/100cm <sup>2</sup> total 100 dpm/100cm <sup>2</sup> averaged over 1m <sup>2</sup>  Beta/gamma contamination >1000 dpm/100cm <sup>2</sup> removable >5000 dpm/100cm <sup>2</sup> total	Suspend operations secure area and notify the Field Supervisor and Radiological Safety	Prior to removal from radiological control area
Personnel contamination	>MDC of instrument	Suspend operations secure area and notify the Field Supervisor and Radiological Safety	Prior to exiting radiological control areas
Long lived radioactive airborne particulates	10% of the DAC <sup>1</sup> (if full facepiece air purifying respirators are not worn) 50 DAC (if full facepiece air purifying respirators are worn)	Remove personnel from effected area suspend operations secure area and notify the Field Supervisor and Radiological Safety	Per the Radiological Work Permit
Low Energy X Ray and Gamma radiation (FIDLER)	>5000 cpm	Suspend Operations Notify the Field Supervisor and Radiological Safety  Segregate soil	Each bucket or at the discretion of the Radiological Engineer per the Sampling and Analysis Plan
<sup>1</sup> DAC Derived Air Concentration			

**Table 7.3**  
**Monitoring Program Summary (cont.)**

<b>CHEMICAL</b>			
<b>Hazard</b>	<b>Action Level</b>	<b>Action(s) to be Taken</b>	<b>Monitoring Frequency</b>
Volatle organic compounds	> Background (if supplied air respirators are not worn)	Remove personnel from effected area or don Level B respiratory protection	Continuous in the CRZ/RBA and Project Support Zone during excavation and dumping

<b>NOISE</b>			
<b>Hazard</b>	<b>Action Level</b>	<b>Action(s) to be Taken</b>	<b>Monitoring Frequency</b>
Short term high noise levels	> 85 dBA	Don suitable hearing protection Initiate noise dosimetry	As needed to characterize new equipment and/or operations
Continuous high noise levels	> 85dBA average over 8-hour shift	Don suitable hearing protection Participation in a Hearing Conservation Program.	As needed to characterize new equipment and/or operations

<b>RESPIRABLE DUST</b>			
<b>Hazard</b>	<b>Action Level</b>	<b>Action(s) to be Taken</b>	<b>Monitoring Frequency</b>
Inhalation of dust	1.5mg/m <sup>3</sup>	Remove personnel from effected area or don full face-piece air purifying respirators (APRs) with HEPA cartridges (in the absence of chemical contamination)	Continuous during dust generating activities

**Table 7 3**  
**Monitoring Program Summary (cont )**

<b>HEAT STRESS</b>			
<b>Hazard</b>	<b>Action Level</b>	<b>Action(s) to be Taken</b>	<b>Monitoring Frequency</b>
Heat stress	Varies depending on work load and if PPE is worn <sup>1</sup>	Work rest regimen ice vests or other RMRS approved measures	Varies depending on work load and if PPE is worn <sup>1</sup>
<sup>1</sup> Monitoring will be performed when work area temperature exceeds 77 F See Appendix D for guidance and action levels for work involving the use of personal protective equipment			

<b>COLD STRESS</b>			
<b>Hazard</b>	<b>Action Level</b>	<b>Action(s) to be Taken</b>	<b>Monitoring Frequency</b>
Cold stress	40 F Equivalent chill temperature <sup>1</sup>	Wear adequate insulated dry clothing	Continuous when the equivalent chill temperature is <40 F
Cold stress aggravated by the use of evaporative liquids such as gasoline	39.2 F Equivalent chill temperature	Avoid soaking clothing or gloves with evaporative liquids	Continuous when the equivalent chill temperature is <40 F
Cold stress	19.4 F Equivalent chill temperature	Work warm regimen will be instituted <sup>2</sup>	Continuous when the equivalent chill temperature is <40°F
Equivalent chill temperature is the combined effect of the air temperature and wind speed See Appendix D for ACGIH table used to calculate equivalent chill temperature <sup>2</sup> See Appendix D for ACGIH work warm regimen schedule			

**Table 7.3**  
**Monitoring Program Summary (cont )**

<b>EXPLOSIVE ATMOSPHERES</b>			
<b>Hazard</b>	<b>Action Level</b>	<b>Action(s) to be Taken</b>	<b>Monitoring Frequency</b>
Explosion	> 10% of lower explosive limit	Suspend operations and notify the Field Supervisor	At the discretion of the SSO and HSS

<b>WIND SPEED</b>			
<b>Hazard</b>	<b>Action Level</b>	<b>Action(s) to be Taken</b>	<b>Monitoring Frequency</b>
Contamination dispersion	> 15 mph average for two consecutive 15 minute periods	At the discretion of the Project Manager and the Site Safety Officer	Continuous during all field activities
Contamination dispersion	> 30 mph average for two consecutive 15 minute periods	Terminate dust generating activities	Continuous during all field activities.
Personnel injury	> 45 mph average for two consecutive 15 minute periods	Secure area and terminate field operations	Continuous during all field activities



#### **7 4 1 Chemical Monitoring**

Air monitoring for VOCs will be conducted using a Foxboro, Inc , Model TVA-1000 which uses both a photoionization detector (PID) and a flame ionization detector (FID) to measure airborne concentrations of VOCs and SVOCs. The PID is equipped with a 10.6 eV lamp and has a range of 0-2,000 ppm and the FID has a range of 0-50,000 ppm. Both the PID and FID will be calibrated daily prior to use and a yearly factory calibration and service is recommended. Daily calibrations will be per the manufacturers specifications and results will be entered in the Industrial Hygiene Instrumentation Calibration Logbook. The lamp, probe, and filters will be cleaned and/or replaced periodically. When measuring mixtures of volatile organic compounds, PID/FID devices are used as a screening instrument and cannot identify and quantify specific volatile organic compounds within the mixture. Due to the variable response of the PID/FID to different compounds, and the inability to identify the specific compound within the mixture, any reading above background will be the action level unless the compound of concern and the PID/FID response factors are known.

Air monitoring for VOCs will also be conducted using a HNU Systems, Inc , Model DL-101-2, Photoionization Detector (PID) equipped with a 11.7 eV lamp. The PID measures the concentration of airborne concentration of VOCs in parts per million (ppm) using the principle of photoionization. The PID has a range of 0 - 2000 ppm. The PID will be calibrated daily with a 100 ppm standard of isobutylene prior to use and a yearly factory calibration is recommended. Daily calibration will be per the manufacturers specifications and results will be entered in the Industrial Hygiene Instrumentation Calibration Logbook. The lamp, probe and filters will be cleaned and/or replaced periodically.

#### **7 4 2 Radiological Monitoring**

The radiation exposure of an occupational worker will be maintained as far below the U.S. Department of Energy (DOE) limits as is reasonably achievable (ALARA). A local annual administrative dose equivalent level of 750 mrem committed effective dose equivalent is in effect. Based on process history knowledge of the Mound Site soils, the total expected exposure to workers is less than 5 mrem. To ensure that radiological exposures are maintained as low as reasonably achievable (ALARA), personnel and equipment will be monitored using a variety of techniques which are discussed in the following sections.

##### **7 4 2 1 Personnel and Equipment Monitoring**

Personnel leaving the EZ/SCA will enter the CRZ/RBA where they will be monitored by RCTs for radioactive contamination in accordance with ROI-2.01. If personnel contamination is detected, operations will be terminated, the area will be secured, and the Project Manager, Field Supervisor, and Radiological Engineering will be notified. Depending on the location and level of the contamination, further actions will be taken.

After any necessary decontamination, all equipment and materials leaving the EZ/SCA will be surveyed, and released by RCTs in accordance with ROI-3 01, "Performance of Surface Contamination Surveys" and ROI-3 02, "Radiological Requirements for Uncontrolled Release"

Instrumentation to be used for personnel and equipment contamination monitoring are those recommended by RFETS Radiological Safety and consist of the following

- NE Technology, Model Electra, with dual alpha/beta probe,
- Eberline, Model SAC-4, alpha smear counter,
- Eberline, Model BC-4, beta/gamma smear counter; and
- Science Applications International Corp , Model AP-2, portable alpha analyzer

Any alternate instruments will be approved by RFETS Radiological Engineering All instruments will be maintained, calibrated, performance tested, and used in accordance with the RFETS Radiological Operating Instructions Manual

#### **7 4.2.2 Soil Monitoring**

During site preparation, excavation, and reclamation, monitoring of the soil will be required Monitoring of the soil will be conducted using a Bicron, Corp , Model Analyst equipped with a G5 probe which is a field instrument for detecting low energy radiation (FIDLER) The FIDLER will be maintained, calibrated, and used in accordance with the ROI-6 6, "Use of the Bicron FIDLER"

#### **7 4 2.3 Radioactive Air Particulate Monitoring**

Radiological air monitoring will be performed in accordance with the RWP and will consist of high volume and low volume air sampling

High volume air monitoring will be conducted at the EZ/SCZ boundary at both the excavation and the CSFS to ensure that levels of airborne radioactive particulates are <10% of the DAC Monitoring will be accomplished using Staplex Company, Inc , Model TFIA, high volume air samplers which will be maintained, calibrated, and used in accordance with ROI-4 02, "Air Sampling"

Low volume air monitoring will be conducted in the support zone perimeter at both the excavation and the CSFS to ensure that levels of airborne radioactive particulates are <10% of the DAC Monitoring will be accomplished using Radeco, Model HD-66A, or Gast, Model RV23-14CV low volume air samplers which will be maintained, calibrated, and used in accordance with ROI-4 03, "Portable Low Volume Air Sampling"

#### **7 4 2 4 External Radiation Monitoring**

After successful completion of the medical and training requirements specified in Section 6 0 of this plan, employees who will work within the SCA and RBA will be issued thermoluminescent dosimeters. Dosimeters will be issued, worn, stored and processed in accordance with HSP-18 07, 'External Radiation Dosimetry

#### **7 4 2 5 Internal Radiation Monitoring**

Employees who are issued dosimeter badges are subject to periodic urine and/or fecal samples which are collected and analyzed in accordance with HSP-18 20, Routine Bioassay Monitoring Program. Additional urine and/or fecal bioassay samples may be required as determined by RFETS Radiological Safety

#### **7 4 3 Miscellaneous Monitoring**

In addition to chemical and radiological monitoring, numerous other potential hazards exist which require the use of real time monitoring instruments. These hazards include noise, respirable dust, wind speed, heat stress, and explosive atmospheres.

##### **7 4 3 1 Noise Monitoring**

Noise levels will be monitored to delineate areas or activities where hearing protection is required, the effectiveness of hearing protection required, and whether or not personnel need to participate in a Hearing Conservation Program. The instrument used will be an Ametek, Model MK-3, audio dosimeter. The MK-3 is a microprocessor controlled personal monitor that measures noise exposure in the dBA range and displays a variety of results including real time dBA level, exposure time, exposure dose, average dBA level, maximum dBA level, and the 8-hour time weighted exposure dose. The MK-3 is calibrated on a daily basis before and after use. Daily calibrations will be per the manufacturers specifications and results will be entered in the Industrial Hygiene Instrumentation Calibration Logbook. Annual calibration and service of the instrument and the calibrator is required.

##### **7 4 3 2 Respirable Dust Monitoring**

Respirable dust monitoring will be accomplished using a Monitoring Instruments for the Environment Inc., Model PDM-3, Miniature Real-time Aerosol Monitor (Miniram). The miniram is an airborne particulate monitor whose operating principle is based on the scattered electromagnetic radiation in the near infrared. The miniram continuously senses the particles in the sensing chamber and displays the dust levels in mg/m<sup>3</sup>. Because the miniram is preferential to particles 0.1 to 10 micrometers in size, it is useful in determining the levels of not only respirable dust but fumes, smokes, and fogs. The instrument

will be calibrated using a dust free Z-Bag prior to each use and periodic cleaning of the sensing chamber is required. Daily calibration will be per the manufacturers specifications and results will be entered in the Industrial Hygiene Instrumentation Calibration Logbook. A yearly factory calibration and servicing is recommended. Monitoring will be conducted during all dust generating activities.

#### **7.4.3.3 Wind Speed Monitoring**

Wind speed will be monitored throughout all phases of the project to ensure compliance with FO 01, "Air Monitoring and Dust Control." This will be done by the use of a weather station which will also be capable of monitoring wind direction and temperature. A Davis Instruments, Corp., Model Turbo Meter, electronic wind speed monitor will also be used. The Turbo Meter uses a turbine which is suspended on sapphire jewel bearings. The turbine rotation is sensed by an infrared light beam whose signal is processed by a large scale integrated circuit. The Turbo Meter is factory calibrated and requires no maintenance except minor cleaning.

#### **7.4.3.4 Heat Stress Monitoring**

Heat stress monitoring will be completed using a Imaging and Sensing Technology, Model RSS 214, Heat Stress Monitor. The instrument is a micro-processor based Wet Bulb Globe Thermometer (WBGT) which accurately measures environmental factors which contribute to heat stress. The WBGT reading displayed by the instrument, in either fahrenheit or celsius, is a weighted sum of the dry bulb, wet bulb, and verner globe temperatures. The WBGT is calibrated prior to use on a daily basis and a yearly factory calibration and servicing is recommended. Daily calibration will be per the manufacturers specifications and results will be entered in the Industrial Hygiene Instrumentation Calibration Logbook. Maintenance is minimal with only the wet bulb wick requiring periodic replacement. Monitoring frequency will depend on the work area temperature, the type of work being performed, and the type of PPE worn. See Appendix D for guidance and action levels for work involving the use of personal protective equipment. Readings in the field will be logged on the Daily WBGT Log.

#### **7.4.3.5 Cold Stress Monitoring**

Cold stress monitoring will be accomplished by obtaining the air temperature and the wind speed and calculating the equivalent chill temperature using the ACGIH table found in Appendix D. Once in the field, wind speed, temperature, and equivalent chill temperature will be logged on the Daily Wind Speed/Cold Stress Log.

#### **7.4.3.6 Explosive Atmosphere Monitoring**

Air monitoring for explosive atmospheres, if necessary, will be conducted using a Mine Safety Appliances, Co., Model Passport, confined space monitor which also has the capability a measuring

airborne concentrations of carbon monoxide and oxygen. The Passport detects the concentration of explosive gases utilizing a catalyzed detector element and displays the results in percent (0-100) of the lower explosive limit. The Passport is calibrated daily prior to use and requires factory calibration and service on a yearly basis. Daily calibration will be per the manufacturers specifications and results will be entered in the Industrial Hygiene Instrumentation Calibration Logbook.

#### **7.4.4 Personal Integrated Air Sampling**

In addition to real-time monitoring, personal integrated air sampling will be conducted on a daily basis at both the excavation and the CSFS for Carbon Tetrachloride, Methylene Chloride, Tetrachloroethylene (PCE), and Trichloroethylene (TCE). Job functions in the EZ/SCA will be observed in order to sample the highest risk employees. Samples will be obtained using Mine Safety Appliances, Co., Model Escort Elf personal sampling pump. The Escort Elf will be calibrated before and after sampling using an A.P. Buck, Inc., Model M-5 (mini-Buck) primary gas flow calibrator. Daily calibration will be per the manufacturers specifications and results will be entered in the Industrial Hygiene Instrumentation Calibration Logbook. The mini-Buck is a National Institute of Science and Technology (NIST) traceable calibrator which is certified on a yearly basis by the manufacturer. All samples will be obtained in accordance with the procedures contained in the NIOSH Manual of Analytical Methods (see Appendix E). Samples will be analyzed by an American Industrial Hygiene Association (AIHA) accredited laboratory.

### **7.5 DECONTAMINATION**

Personnel and equipment contamination prevention techniques will be used wherever feasible. Personnel will avoid unnecessary contact with soil and will adhere to the work practices outlined in Section 7.6. Heavy equipment will be operated in a manner which limits tire or track contact with contaminated soil and the forty ton dump truck will be carefully loaded to prevent spillage.

#### **7.5.1 Personnel Decontamination**

All personnel exiting the EZ/SCA will enter the CRZ/RBA and must go through a thorough decontamination procedure which will be monitored by the Site Safety Officer. Decontamination of personnel will be done at the boundary of the EZ/SCA in the CRZ/RBA at the stepoff pad and will consist of the following:

- Brushing or scrapping to remove gross decontamination. This will be done carefully so that the integrity of the PPE is not compromised,
- Washing outer shoe covers and gloves in a mild solution of Liquinox® and water using a long handled brush,
- Rinsing outer shoe covers and gloves,

- Removing PPE as outlined in Section 7 3 5,
- A whole body frisk will be conducted, and
- Wash hands and face prior to eating, smoking, or chewing

## **7 5 2 Equipment Decontamination**

All materials and equipment in contact with soils will require decontamination prior to release from the EZ/SCA and prior to free release from RFETS to off site locations. At the discretion of the Project Manager, equipment may be decontaminated in the field or transferred to the Main Decontamination Facility. Field decontamination will be conducted in accordance with FO 03, "Field Decontamination Operations." Main Decontamination Facility operations will be conducted in accordance with FO 04, "Decontamination of Equipment at Decontamination Facilities," and FO 12, "Decontamination Facility Operations." Depending on the location and extent of contamination, and the purpose of the decontamination, one or more of the following methods may be used:

- Spraying potable water at low pressures,
- Spraying potable water at high pressures and high temperatures,
- Scrapping and brushing,
- Scrubbing with solutions of Liquinox®, or Pipex®,
- Wiping with premoistened, non-alcohol based wipes, and
- Rinsing with deionized water

Decontamination effectiveness will be determined using radiological and volatile organic vapor monitoring instruments.

## **7 5.3 Management of Decontamination Liquids and Incidental Waters**

Liquids generated during decontaminations will be sprayed on the CSFS or placed in holding tanks which will also hold incidental waters pumped from either the excavation or the CSFS stormwater collection system. Incidental water and decontamination liquids will be handled in accordance with SW 01, "Control and Disposition of Incidental Waters," and FO 07, "Handling of Decontamination Water and Wash Water." When needed, the liquids will be pumped from the holding tanks into tanker trucks for transport to Building 891 and subsequent treatment.

## **7 6 WORK PRACTICES**

### **7 6 1 Radiological Work Permit (RWP)**

Work within the radiological control areas will be conducted under the stipulations of several Radiological Work Permits which will be strictly adhered to at all times. Any personnel conducting work contrary to the RWP will be subject to immediate disciplinary action and removed from the project.

### **7 6 2 Prohibited Activities**

The following activities are prohibited:

- Eating, drinking, chewing gum or tobacco, and smoking is prohibited within the CRZ/RBA and EZ/SCA,
- Unnecessary contact with contaminated soil such as sitting and kneeling,
- Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth transfer and ingestion of material is prohibited except in designated areas,
- Prescribed drugs taken by personnel on operations where the potential for absorption, inhalation, or ingestion of toxic substances exists unless specifically approved by a qualified physician,
- Eating, drinking, smoking or chewing gum or tobacco prior to washing hands and face after exiting the exclusion zone,
- Facial hair which interferes with mask to face seal,
- Hard, non-permeable contact lenses are prohibited in the EZ/SCA, and
- Lighters and matches on site except in designated smoking areas.

### **7 6 3 Spill Prevention**

It is the responsibility of all project personnel to conduct work in a manner which prevents the potential release or spill of hazardous materials. The observance of any activity which increases the potential for a release or spill shall be immediately reported to the Field Supervisor or Project Manager. Spill prevention will include the following work practices:

- A one foot freeboard will be maintained in dump trucks,
- Dump trucks will be free of external soil accumulation prior to transport,
- Dump trucks will be limited to 5 mph during transport,
- Heavy equipment and generators will be carefully refueled so as not to overfill,
- Gasoline containers will be stored in flammable cabinets when not in use,
- Heavy equipment will be inspected by the operator prior to the beginning of each shift and an inspection checklist will be completed,
- Pumps and hoses used to pump incidental water to holding tanks will be visually inspected by the

- user prior to each operation,
- Tanks used to hold incidental water and decontamination liquids will be inspected daily, and
- Tanker trucks used to transfer incidental water and decontamination liquids will be filled in accordance with their safety guidelines

#### **7 6 4 Dust Control Measures**

To prevent windblown dispersion and employee inhalation of particulates, FO 01 will be strictly adhered to and potable water will be sprayed for routine dust suppression during excavation, loading, transport, dumping, and stockpiling of contaminated soil. Water will be sprayed to moisten, not mobilize the soil or create runoff. The contaminated soil feed stockpile will be covered with a tarp and the excavation will be sprayed with potable water at the end of each shift. Wind speed will be monitored as described in Section 7 4 3 3 and the action levels in Table 7 3 will be adhered to. Dump trucks used to transport contaminated soil will be limited to a maximum speed of 5 mph.

#### **7 6 5 Buddy System**

All work that requires personnel to directly handle, sample or transport hazardous materials, hazardous waste or waste containers at RFETS requires the use of the buddy system. The responsibility of workers utilizing the buddy system include

- Providing his/her partner with routine and emergency assistance,
- Observing his/her partner for signs of chemical or heat stress exposure,
- Periodically checking the integrity of his/her partner's PPE, and

In addition, any work requiring greater than Level D protection requires use of the buddy system. At no time shall any worker enter the EZ/SCA or CRZ/RBA without the use of the buddy system.

#### **7 6 6 Communications**

Due to the small work areas at the excavation and CSFS and requirement of the "buddy system" during work activities, face to face communication among workers will be generally maintained. However, due to the use of Level B respiratory protection and the difficulty in communicating, a set of hand signals has been developed and personnel will be briefed on their use prior to beginning work. Radios will be used for communicating with workers in the EZ/SCA and other plant personnel including emergency responders. EMAD-6 will be used for communication during the duration of this project. In addition, a telephone is located in T900D.



### **7 6 7 Confined Space Entry**

Confined space entry is not authorized for this project. If it is determined during the course of field activities that a confined space entry (i.e., entry into the excavation) is required, an addendum to this HASP will be required.

### **7 6 8 Illumination**

Night work is not anticipated during this project. If night work is required, it will be performed in compliance with 29 CFR 1926.65(m), Illumination.

### **7 6 9 Sanitation**

Potable water washing and toilet facilities which comply with 29 CFR 1926.65(n) Sanitation at Temporary Work Places and will be available to all on-site personnel.

## **7 7 UNANTICIPATED HAZARDS OR CONDITIONS**

Unanticipated hazards or conditions encountered during this project will be managed in accordance with this RMRS policy statement: "In the event unanticipated hazards or conditions are encountered, the project activities will pause to assess the potential hazard or condition. The potential hazard or condition will be evaluated to determine the severity or significance of the hazard or condition and whether the controls on the project are sufficient to address the hazard or condition. Based on this initial evaluation, a determination will be made whether to proceed with controls currently in place, segregate the hazard or condition from the project activity, if it can be done safely, or curtail operations to address the unexpected hazard or condition. Concurrence to proceed down the selected path must be obtained from the RMRS Vice President or their designee. In addition, the resumption of field activities involving radiological issues will be in accordance with Article 345 of the RFETS Radiological Control Manual. **Note:** Unanticipated Hazards or Conditions do not replace conditions which require emergency response; rather, they ensure that all work is performed based on an informed approach in regards to all potential hazards.

The following sections list possible Unanticipated Hazards or Conditions and the corresponding response action.

### **7 7 1 Encountering Debris During Excavation**

Historical data indicates that all debris associated with the Mound Site was removed during the 1970 drum removal activities (DOW Chemical Company Rock Flats Division, Letter from R. M. Vogel to E. A. Putzier titled "Logistics of Mound Excavation," dated September 11, 1970). In the unlikely event that

drums, wood, metal, plastic, rubber, fiberglass or other non-natural debris is found during excavation activities, the following actions will be taken

- Excavation activities will be immediately suspended and the Project Manager and Field Supervisor will be notified,
- Radiological Safety will be notified,
- Information regarding the debris will be gathered This will include any labels, markings, or other visual clues as to the nature of the debris,
- Upon approval from the Project Manager or Field Supervisor, and the Radiological Safety Section Manager/RCT Supervisor, the debris will be removed from the excavation and placed on plastic sheeting where it can be surveyed for radiological contamination per ROI-3 01, "Performance of Surface Contamination Surveys", monitored for volatile organic compounds, and further characterized as necessary,
- Based on the radiological survey, VOC monitoring results, and other characterization data, the area radiological postings, RWP, controls, and work practices will be reviewed and modified as necessary, and
- Upon approval from the RMRS Vice President or their designee, excavation activities will resume

#### **7 7 2 Soil Surface FIDLER Readings >5,000 CPM**

FIDLER readings will be taken on the surface of soil removed from the excavation If levels > 5,000 cpm are detected, the following actions will be taken

- Excavation activities will be immediately suspended and the Project Manager or Field Supervisor will be notified,
- Radiological Safety will be notified,
- A plastic covered soil segregation area will be established at the excavation site,
- Based on the FIDLER readings, the area radiological postings, RWP, controls, and work practices will be reviewed and modified as necessary,
- Upon approval from the RMRS Vice President or their designee, excavation activities will resume,
- A composite sample of the segregated soil will be submitted for isotopic analysis,
- The soil will be covered at the end of the day or when segregation is no longer required,
- Based on the sample results, the area radiological postings, RWP, controls, and work practices will be reviewed and modified as necessary, and
- Upon approval from the RMRS Vice President or their designee , the segregated soil will be handled appropriately

### **7 7 3 Perimeter Radiological Air Sample Results > 10% DAC**

In order to protect collocated in the CRZ/RBA and project support zone, perimeter or work area high volume and low volume air samples will be obtained. If a confirmed sampling result is greater than 10% of the DAC, the following actions will be taken:

- All activities will be immediately suspended and the Project Manager or Field Supervisor will be notified,
- The Shift Supervisor will be notified and access to downwind areas will be restricted,
- Radiological Safety will be notified,
- All personnel in the CRZ/RBA and support zone will be moved to a safe upwind assembly area. No personnel will be allowed to leave the assembly area,
- A Science Applications International Corp Model AP-2 portable alpha analyzer will be used to determine if the elevated sample result is due to naturally occurring radioactive material or radioactive contaminants of concern,
- Based on sample and monitoring results, potential personal radiological exposures will be reviewed,
- Based on the sample results, the area radiological postings, RWP, controls and work practices will be reviewed and modified as necessary, and
- Upon approval from the RMRS Vice President or their designee, work activities will resume.

### **7 7 4 Equipment Radiological Contamination > Transuranic Release Limits**

All material and equipment exiting the radiological control areas at the excavation and the CSFS will be surveyed per ROI-3 01. Should any survey results indicate contamination levels greater than those in the RFETS Radiological Control Manual, Table 2-2, the following actions will be taken:

- All activities will be immediately suspended and the Project Manager and Field Supervisor will be notified,
- Radiological Safety will be notified,
- The source of the contamination will be identified and controlled,
- The contaminated material or equipment will be contained, handled, and transferred in accordance with HSP-18 10, Radioactive Material Transfer and Unrestricted Release of Property and Waste ,
- Based on the survey results, the area radiological postings, RWP, controls, and work practices will be reviewed and modified as necessary, and
- Upon approval from the RMRS Vice President or their designee, work activities will resume.

### **7 7 5 Personal Radiological Contamination**

All personnel will be frisked per ROI-2 01 prior to exiting the radiological control areas at the excavation and the CSFS. If levels >MDC of the instrument are detected on personnel after the removal of personal protective equipment, the following actions will be taken:

- All activities will be immediately suspended and the Project Manager and Field Supervisor will be notified,
- Radiological Safety will be notified,
- Depending on the location and level of contamination the, appropriate actions will be taken to protect the contaminated individual and personnel in the area,
- The source of the contamination will be identified and controlled,
- Based on the contamination levels, the area postings, RWP, and work practices will be reviewed and modified, and
- Upon approval from the RMRS Vice President or their designee, work activities will resume

### **7 7 6 Perimeter VOC Monitoring > Background**

In order to protect collocated in the CRZ/RBA and project support zone, perimeter VOC air monitoring will be conducted at both the excavation and the CSFS. Should levels indicate the sustained presence of VOCs at levels greater than background, the following actions will be taken:

- All activities will be immediately suspended and the Project Manager and Field Supervisor will be notified,
- All personnel in the CRZ/RBA and support zone will be moved to a safe upwind location,
- Based on monitoring results potential personal chemical exposures will be reviewed,
- Based on monitoring results, site control and work practices will be reviewed and modified, and
- Upon approval from the RMRS Vice President or their designee, work activities will resume

## **8 0      EMERGENCY RESPONSE PLAN**

Potential emergency situations during work at the Mound Site include hazardous substance release, employee contamination, accidents, injuries, fire, and natural disasters. Safety precautions will be taken to avoid emergency situations. However, if an emergency does arise, the procedures described in this section will be followed. Also, preparatory steps necessary for responding to an emergency situation are given below and they should be complied with before beginning any work at the site.

The Project Manager, with assistance from the Field Supervisor and the Site Safety Officer, has responsibility and authority for coordinating all evacuations and emergency response activities until proper authorities arrive and assume control.

## **8 1      SITE EVACUATION**

If an evacuation is necessary at the excavation area, personnel will exit the site via the nearest stepoff pad and proceed to the primary assembly area. The need for personal decontamination and radiological frisking will be evaluated based on the reason for the evacuation and will be communicated to field employees by means of a distinct air horn signal. One long blast from the air horn indicates a controlled evacuation requiring both decontamination and radiological frisking. Three short blasts will indicate an emergency evacuation during which personnel will immediately evacuate the site without stopping for decontamination or personal radiological frisking. NOTE: During an emergency evacuation, there are no operations within the excavation area that are vital enough to delay the evacuation for even an instant. Because the wind is usually from the northwest, the primary assembly area will be the corner of the protected area fence located approximately 200 feet to the west. Should this area be upwind, the secondary assembly area will be Building 301 located approximately 200 feet to the east. All personnel will be accounted for once they reach the assembly area.

If an evacuation is necessary at the CSFS area, personnel will exit the site via the nearest stepoff pad and proceed to the primary assembly area. The need for personal decontamination and radiological frisking will be evaluated based on the reason for the evacuation and will be communicated to field employees by means of a distinct air horn signal. One long blast from the air horn indicates a controlled evacuation requiring both decontamination and radiological frisking. Three short blasts will indicate an emergency evacuation in which personnel will immediately evacuate the site without stopping for decontamination or personal radiological frisking. NOTE: During an emergency evacuation, there are no operations within the CSFS that are vital enough to delay the evacuation for even an instant. Because the wind is usually from the northwest, the primary assembly area will be the west end of T900C located approximately 200 feet to the west. Should this area be upwind, the secondary assembly area will be approximately 200 feet east of the CSFS area. All personnel will be accounted for once they reach the assembly area.

Assembly areas are shown on the Mound site maps (Figures 3 2, 3 3, and 3 4) which will be posted next to the telephones and in prominent locations at the site

## **8 2 EMERGENCY SERVICES**

### **8 2 1 Emergency Phone Numbers**

In case of an emergency, RFETS emergency services must be notified Kaiser-Hill maintains an emergency response telephone extension of 2911 at RFETS Extension 2911 may be reached from any plant site telephone or on Radio Channel 2911 and will immediately connect the caller with the Fire Department, Plant Security, the Central Alarm Station, the Shift Superintendent and, during first shift, Occupational Health Table 8 1 presents a list of Mound Site project personnel who will be notified in the event of any spill, release, employee contamination, accident, injury, fire, or natural disaster These phone, radio and pager numbers will be posted next to telephones and at prominent locations at the site Any revisions to the list must be posted and all personnel notified of the changes

**\*All Life Threatening Emergencies\* Dial Extension 2911**

### **8 2 2 Rocky Flats Occupational Health Medical Facility (Building 122)**

The Rocky Flats Medical Facility in Building 122 is to be used for medical injuries and emergencies Depending on the seriousness of the injury, injured personnel may also require care by an off-site hospital The need for off-site care will be determined by Occupational Health Directions to the Rocky Flats Occupational Health Medical Facility

From the Mound Site or the CSFS, go south to Central Avenue and turn right (west) onto Central Avenue Continue for approximately 1 25 miles Building 122 will be on the left (south) side of Central Avenue A map to Building 122 will be posted next to telephones and at prominent locations at the site See Figure 8 1

**Table 8 1**  
**Emergency Telephone Numbers**

**RFETS EMERGENCY RESPONSE EXTENSION**

**RFETS Phone. 2911**

**RFETS Radio. 2911**

**RFETS SHIFT SUPERINTENDENT**

**RFETS Phone. 2914**

**RFETS Radio. 2914**

**RMRS Emergency Contacts**

Contact Wayne Sproles  
RMRS Project Manager

RFETS Phone 5790

RFETS Radio 3798

RFETS Pager 1245

Contact Mark Wood  
RMRS Field Supervisor

RFETS Phone 6689

RFETS Radio 3796

RFETS Pager 5904

Contact Peggy Schreckengast  
RMRS Health and Safety Supervisor

RFETS Phone 6790

RFETS Radio 3359

RFETS Pager 3059

Contact Marla Broussard  
RMRS Field Operations Manager

RFETS Phone 6007

RFETS Radio 3740

RFETS Pager 4010

Contact Jerry Anderson  
RMRS Radiological Coordinator

RFETS Phone 6438

RFETS Radio

RFETS Pager 7447

**Figure 8.1**  
**Map to RFETS**  
**Medical - Building 122**

**EXPLANATION**

Emergency Facility

Emergency House

Standard Map Features

Building & other structures

Lanes and ponds

Streams, ditches, or other drainage features

Fences

Rocky field boundary

Revised roads

Dirt roads

Map features not shown include:  
 - All buildings  
 - All roads  
 - All fences  
 - All streams, ditches, or other drainage features  
 - All rocky field boundaries  
 - All revised roads  
 - All dirt roads



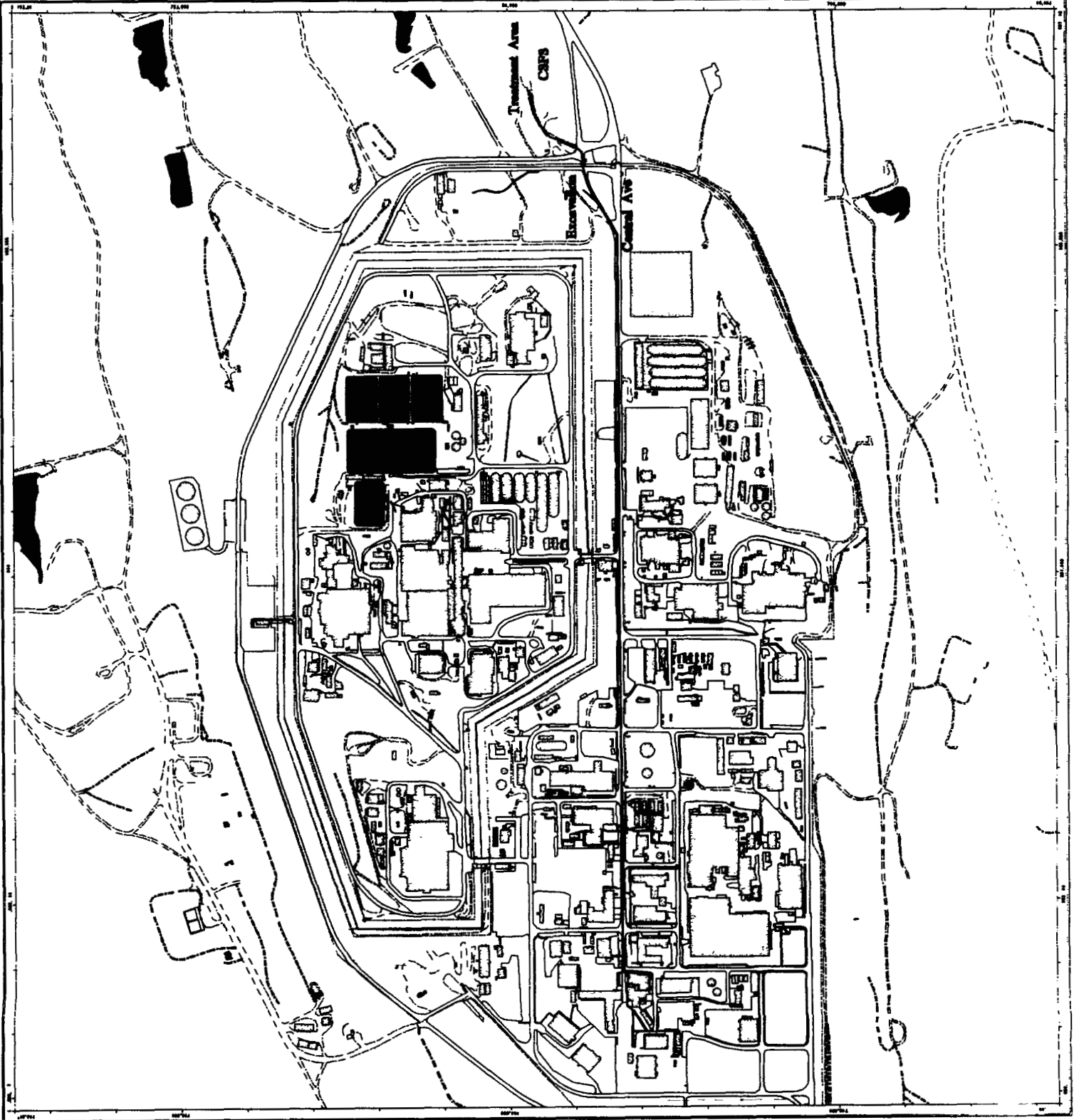
1 inch equals 1 mile



Scale of map is 1:62,500

U.S. Department of Energy  
 Rocky Flats Environmental Technology Site

**RFETS**  
 Rocky Flats Environmental Technology Site  
 U.S. Department of Energy  
 1600 15th Avenue  
 Golden, Colorado 80601  
 (303) 427-1000





## **8.3 HAZARDOUS SUBSTANCE RELEASE**

### **8.3.1 Spill Response Planning**

The Spill Response Plan is designed to establish a program/plan to optimize a safe and informed response to incidental and emergency situations with the intent of protecting Mound Site project personnel, collocated workers, the public, the environment, and property in the event of spills, fire, or explosion. All spills will be addressed per HSP-21 04, "Emergency Response and Spill Control Program." If applicable, reporting will be conducted in accordance with Administrative Procedures Manual, ADM-16 01, "Occurrence Reporting Process."

### **8.3.2 Incidental Spill Operations**

#### **Incidental Spill Definition**

Incidental spills are those where the substance can be safely absorbed, neutralized, or otherwise controlled by employees in the immediate release area at the time of the release. In addition, the release does not have the potential to become an emergency within a short time frame.

Spills considered as incidental include

- Gasoline, diesel, or hydraulic oil spills within the EZ/SCA,
- Gasoline, diesel, or hydraulic oil spills outside of the EZ/SCA,
- Contaminated soil spills outside of the EZ/SCA, and
- Decontamination or incidental water spills inside secondary containments.

Criteria which must be met prior to incidental release response actions at the Mound Site include

- The RFETS Shift Superintendent must be notified,
- The RMRS Project Manager and RMRS Field Supervisors must be notified,
- Radiological Safety must be notified if spill involves radiological aspects,
- The chemical hazards of the substance spilled are known and quantified,
- The PPE normally worn will provide adequate personal protection,
- Decontamination methods are suitable for the substance spilled, and
- All materials or equipment used during the response are compatible with the substance spilled.

Post incidental spill response will include

- Ensuring the proper reporting per HSP-21 04 and ADM-16 01, and
- Conducting a briefing to address the cause of the spill, methods of preventing future spills, and ways to improve readiness and response.

### 8 3 3 Emergency Spill Operations

#### Emergency Response Definition

A response effort by personnel from outside the immediate release area, or by other designated responders to a release that results, or is likely to result , in an uncontrolled release of a hazardous substance

An emergency response is required in the following situations

- The responders are not in the immediate response area,
- The release requires emergency evacuation of employees in the area,
- The release poses a serious threat of fire or explosion (exceeds or has the potential to exceed the lower flammable limit),
- The release may cause high levels of exposure to toxic substances, and
- There is uncertainty that the employees in the work area can safely handle the severity of the hazard with the available PPE and equipment

#### Emergency Spill Response Actions

- IF a release is observed, THEN immediately warn coworkers in the area and notify the Project Manager or Field Supervisor on EMAD 6 IF supervision is not available, notify the Shift Supervisor at 966-2914,
- Shut off pumps transferring liquid if safe to do so,
- Close valves to stop flow into affected area if safe to do so,
- Move to a safe location upwind and post a person upwind to prevent unauthorized personnel from entering the contaminated area, and
- Call 966-2911 or use radio channel 2911 and provide the following information
  - Exact location of the emergency (nearest road, etc )
  - Nature of the emergency
  - Condition of patient if applicable (breathing, consciousness, bleeding, etc )
  - Special hazards in the area
  - Your name
  - Any other information requested

## **8 4 EMPLOYEE CONTAMINATION**

### **8 4 1 Chemical Contamination**

If any site worker experiences a failure or alteration of protective equipment that affects the protection factor, that person and his/her coworker(s) will immediately leave the work area for which the PPE was required. Re-entry to the area will not be permitted until the equipment has been repaired or replaced. If any incidents occur that involve the chemical contamination or exposure of an employee to hazardous or toxic substances, the Project Manager or Field Supervisor will be notified immediately. If necessary, the RFETS emergency services at extension 2911 shall be notified.

First aid or other decontamination procedures should be administered if they can be without endangering other operations personnel. Chemically contaminated personnel should proceed to the nearest decontamination safety shower and thoroughly irrigate the contaminated area(s). An emergency shower and eyewash station is located in the excavation support zone and in T900D at the CSFS area. No chemical contamination situation at the Mound Site project will be made worse by the use of large amounts of water.

### **8 4 2 Radiological Contamination**

All personnel radiological contamination will be addressed in accordance with ROI-2 01.

## **8 5 ACCIDENT/INJURY**

In the event of an accident or other event that causes injury to operations or any other personnel present at the Mound Site project, the RFETS emergency extension at 2911 will be notified immediately. The site Fire Department, EMTs, and Security will be dispatched immediately. Details of the emergency and the exact location must be given over the phone. Basic first aid may be administered by properly trained personnel until emergency medical personnel arrive. Each shift will have a minimum of one staff member trained in American Red Cross First Aid and CPR. Any non-emergency medical situation such as minor cuts or sprains should be attended to at RFETS Medical - Building 122. A map showing the location of Building 122 is shown in Figure 8 1.

Field Change No 2

Field Change No 2

## **8 5 1 Emergency Medical Procedures**

For severe injuries, illnesses, or overexposures

- Remove the injure or exposed person(s) from immediate danger if safe to do so,
- Immediately call extension 2911 and provide as much information as possible,
- If possible, at least partial decontamination should be completed Remove protective equipment and clothing and redress the victim in clean coveralls or wrap in a blanket,
- If decontamination cannot be done, wrap the victim in blankets or plastic sheeting to reduce contamination of other personnel,
- Render emergency first aid until emergency medical personnel arrive, and
- Evacuate all personnel on site to a safe place

## **8 5 2 Fire/Explosion**

The first responsibility of any employee discovering a fire is to warn coworkers and Call the Rocky Flats Fire Department at extension 2911

UNDER NO CIRCUMSTANCES SHOULD ANYONE ATTEMPT TO FIGHT A FIRE ALONE  
Personnel trained as First Responders may then use a fire extinguisher or de-energize small fires in those situations where there is no personal danger in doing so Fire extinguishers are located next to all generators on site, in T900C and T900D, and in all pieces of heavy equipment

In the event of an explosion, all personnel will be evacuated and the fire department notified No personnel shall re-enter the area until it has been cleared by the Rocky Flats Fire Department

## **8 5 3 Natural Disasters**

Natural disasters may occur at the site and include lightning and high winds

- Lightning - Persons should not work in open areas, near trees or other equipment outside during lightning storms - Stop work and clear the site until storm passes
- High winds - If high winds are forecast, the site should be cleared before the winds become hazardous Workers should be instructed to go to an appropriate shelter If winds are sustained at 30 miles per hour, all soil handling activities will be suspended and work activities will be evaluated If winds are sustained at 45 miles per hour, all work will be stopped until the wind subsides
- Notify the Project Manager or Field Supervisor of any work stoppage due to lightning and high winds

## 8 6 EMERGENCY EQUIPMENT

This equipment will be stored at appropriate locations selected during site mobilization

- Fire extinguishers (10 lb A/B/C),
- Extra full set of PPE including SCBA,
- Emergency shower and eyewash stations will be provided and maintained in the support zone at both the CSFS and the excavation, and
- Fully stocked spill kit including
  - Caution Tape
  - Oil dry absorbent
  - Universal absorbent pads
  - Universal absorbent pillows
  - Universal absorbent booms
  - Plastic non-sparking shovel
  - Large plastic bags
  - White vinyl tape
  - Radiological and Hazardous Waste Labels

Field Change No 2



KAISER ♦ HILL  
C O M P A N Y

**INTEROFFICE MEMORANDUM**

DATE February 10, 1997

TO Wayne R Sproles Mound Site Project Manager

FROM *9* D R Swanson, Manager Safety Analysis, Bldg 130, x7009

SUBJECT TRANSMITTAL OF AUDITABLE SAFETY ANALYSIS FOR THE MOUND  
SITE SOURCE REMOVAL PROJECT - DRS-005-97

Ref (a) W R Sproles ltr 97-RF-00536 to Don Swanson Mound Site IHSS  
113, Source Removal Project - Auditable Safety Analysis (ASA) -  
WRS-003-97, January 29 1997

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**PURPOSE**

This letter transmits the completed safety analysis for the Mound Site Source Removal Project in response to your letter (Ref a) requesting an auditable safety analysis be performed

**DISCUSSION**

This report presents a semi-quantitative safety analysis for the activities associated with the Mound Site Source Removal Project. The safety analysis was based on information obtained in the Proposed Action Memorandum (PAM) for the project which includes a summary of the radiological and chemical sampling data, as well as a draft of the Mound Site Health and Safety Plan (HASP)

The safety analysis has determined that the Mound Site is classified as "low hazard non-nuclear" requiring compliance with OSHA Standards, preparation of a site-specific HASP, and preparation of an auditable safety analysis.

Based on the classification determination, the radiological and chemical hazards associated with the Mound Site source removal activities present negligible offsite impacts to the public and the environment resulting from an airborne release. Onsite occupational hazards have been identified and evaluated in the HASP. No additional controls, beyond what is documented in the HASP, have been identified, nor are necessary to further control negligible offsite radiological and chemical hazards. Offsite impacts will be adequately controlled provided that the controls identified in the HASP are implemented and maintained.

W R Sproles  
February 10 1997  
DRS-005-97  
Page 2

RESPONSE

If you have any comments or questions regarding this safety analysis please contact John Kirar at x7844/DP7577 or myself at x7009/DP5269

Attachment  
As stated

cc  
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**SAFETY ANALYSIS**  
for  
**INDIVIDUAL HAZARDOUS SUBSTANCE SITE (IHSS) 113**  
**MOUND SITE SOURCE REMOVAL PROJECT**

Revision 0

February 10, 1997

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## SUMMARY

This safety analysis addresses the activities associated with the removal of Volatile Organic Compounds (VOCs) at the Rocky Flats Environmental Technology Site (RFETS) Individual Hazardous Substance Site (IHSS) 113. The IHSS 113 is also known as the Mound Site.

Between 1954 and 1958 approximately 1,405 intact drums containing uranium, plutonium, beryllium, hydraulic oil, carbon tetrachloride, perchloroethylene (PCE), and trichloroethylene (TCE) were stored at the Mound Site. Prior to removal of the drums in 1970, some of the drums were known to have leaked, and the resulting contamination is impacting the groundwater. It is expected that approximately 400 to 1,000 cubic yards (yd<sup>3</sup>) of soil are contaminated with VOCs above subsurface action levels specified in the Final Rocky Flats Cleanup Agreement (RFCA) (Ref 1) necessitating source removal activities. The VOC contaminants are Comprehensive Environmental Response Compensation and Liability Act (CERCLA) hazardous substances and Resource Conservation and Recovery Act (RCRA) hazardous waste constituents contained in an environmental media (soil). Removal and treatment of VOCs at the Mound Site, in accordance with the RFCA, will mitigate this source of groundwater contamination.

Source removal activities include (1) excavation, (2) staging of contaminated soils, (3) soil treatment, and (4) site reclamation. This analysis addresses only the tasks that could result in a significant airborne release of radiological and chemical contaminants, specifically excavation, stockpiling, and handling of contaminated soils. Contamination of the local groundwater and potential resultant effects to public receptors are not addressed in this analysis as it is assumed that they are adequately covered by CERCLA and RCRA cleanup requirements applicable to this project. Routine and incidental releases of contaminants (chemical and radiological) during source removal activities at the Mound Site are evaluated in the *Site Specific Health and Safety Plan for the Source Removal at the Mound Site IHSS 113* (Ref 2).

Based on a review of the *Proposed Action Memorandum for the Source Removal at the Mound Site IHSS 113* (Ref 3), the *Mound Site Source Removal Project Activity Control Envelope Process*, the site-specific HASP, and guidance set forth in DOE-STD-5502-94, *Hazard Baseline Documentation* (Ref 4), the Mound Site (source removal activities) is classified as "low hazard non-nuclear" requiring compliance with OSHA Standards, preparation of a site-specific Health and Safety Plan (HASP) in accordance with 29 CFR 1926.65, *Hazardous Waste Operations and Emergency Response* (Ref 5), and preparation of an "auditable safety analysis." This safety analysis serves as the "auditable safety analysis."

Based on the "low hazard non-nuclear" hazard classification determination, the radiological and chemical hazards associated with the Mound Site source removal activities present negligible offsite impacts to the public and the environment. Onsite occupational hazards (radiological, chemical, biological, and physical) have been identified and evaluated in the site-specific HASP hazard assessment. Controls for these hazards are also documented in the HASP. No additional controls, beyond what is documented in the HASP, have been identified, nor are necessary to further control negligible offsite radiological and chemical hazards.

**SAFETY ANALYSIS**  
**INDIVIDUAL HAZARDOUS SUBSTANCE SITE (IHSS) 113**  
**MOUND SITE SOURCE REMOVAL PROJECT**

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# 1 INTRODUCTION

The proposed actions that will be undertaken at the Mound Site include excavating soil contaminated with VOCs and processing the soil to remove the VOCs. The Mound Site is located north of Central Avenue, and east of the protected area (PA) fence. The objective of the action is to prevent further degradation of groundwater and to protect human health and the environment. Following treatment, the soil will be returned to the site and the area revegetated. The project will be conducted in accordance with the RFCA guidelines, DOE Orders, and RFETS policies and procedures.

## 1.1 Regulatory Drivers

There are four primary regulatory thresholds or levels used for determining the hazard categorization and appropriate Environmental Management (EM) hazard baseline documentation:

- Hazard Category 3 per DOE Order 5480.23, *Nuclear Safety Analysis Reports* (Ref. 6) and DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23 Nuclear Safety Analysis Reports* (Ref. 7)
- 29 CFR 1910.119, *Process Safety Management (PSM)* (Ref. 8)
- 40 CFR 68, *Risk Management Programs (RMP) for Chemical Accidental Release Prevention* (Ref. 9) and
- 40 CFR 302, *Designation Reportable Quantities and Notification* (Ref. 10)

DOE Order 5480.23 is the primary Order governing safety analysis requirements for nuclear facilities. Facilities are designated as "Nuclear Facilities" if the radiological inventory exceeds the threshold values in DOE-STD-1027-92. DOE-STD-1027-92 identifies the threshold between a Category 3 Nuclear Facility and a below Category 3 Nuclear Facility as a comparison of the total segmented inventory with the values in the standard.

The basis for the application of the PSM Standard, 29 CFR 1910.119, and RMP Rule 40 CFR 68, is the inventory quantity of hazardous substances that is determined by gross amounts (unadjusted by process) of hazardous materials. The PSM Standard was promulgated to prevent and mitigate the effects of major accidents at chemical facilities that can result in loss of life to workers. The RMP Rule was promulgated to prevent and mitigate the effects of accidental releases of hazardous materials that could affect public health and/or the environment. The threshold quantities (TQs) in 29 CFR 1910.119 and 40 CFR 68 are used to trigger PSM and RMP respectively, the results of which would be incorporated in the hazard baseline documentation. Based on the chemical inventory at the Mound Site excavation area, the PSM Standard and RMP Rule are not invoked.

The releasable quantities in 40 CFR 302, Appendix B, *Radiionuclides*, are used to establish the dividing line between radiological or non-nuclear facilities and other EM industrial facilities. The levels in 40 CFR 302 are based on the reportable quantities in pounds of material for hazardous substances and curies of material for radioactive substances. Reportable quantities are based on the potential release of materials into the environment.

DOE-STD-5502-94 (Ref 5) establishes uniform DOE Office of EM Guidance on hazard baseline documents that identify and control radiological and non-radiological hazards for all EM facilities. This DOE Standard requires the cognizant contractor to identify the activities, or groups of activities, that logically should be grouped as a "facility" for the purpose of facility classification and safety and health documentation development.

## **2 ACTIVITY DESCRIPTION**

Source removal activities that will be performed at the Mound Site include

- Excavation
- Staging of Contaminated Soil
- Soil Treatment
- Site Reclamation

### **2.1 Excavation**

The proposed action involves excavating approximately 400 to 1,000 yd<sup>3</sup> of soil from the site using standard excavating equipment. Excavation equipment will consist of a track-mounted excavator, backhoe, and/or front-end loader. Contaminated soils will be moved in dump trucks or by similar transport to a contaminated soil feed stockpile, approximately 600 feet east of the Mound Site, south of where the thermal desorption treatment equipment will be placed to process the soil. During soil handling activities, dust minimization techniques, such as water sprays, will be used to minimize suspension of particulates. Earth-moving operations will not be conducted during periods of high sustained winds. Air monitoring for VOCs and radionuclides will be performed during excavation and transport activities. In addition, radiological monitoring of the soils will be performed for protection of the workers, the public, and the environment in accordance with the RFETS Radiological Controls Manual (Ref 11).

### **2.2 Staging of Contaminated Soil**

The contaminated soil feed stockpile will be designed to contain the contaminated soil and minimize wind blown dispersion and storm water interaction with the soil by using concrete barriers and a water-resistant tarpaulin. In addition, a plastic lined ditch will be constructed surrounding the stockpile to capture local stormwater. Stormwater collected from this ditch may be used to control dust on soils awaiting treatment or will be collected for onsite treatment. Air monitoring for VOCs and radionuclides will be performed during staging of soils in the contaminated soil feed stockpile. Dust minimization will be performed during the staging of soils in the contaminated soil feed stockpile and a water-resistant tarpaulin or equivalent will be placed after daily stockpiling operations.

### **2.3 Soil Treatment**

Contaminated soil will be treated using low temperature thermal desorption remediation technology and stockpiled in the treated soil stockpile area. Air monitoring for VOCs and radionuclides will be performed during soil treatment. Dust minimization will be performed

during the treatment and staging of soils in the treated soil stockpile. Treated soil upon attainment of performance goals, will be backfilled into the excavation. Reclamation of the treatment area and the excavation area will be performed to return these areas to natural conditions.

## **2.4 Site Reclamation**

At the completion of remediation activities (excavation, soil treatment and backfilling) radiological surveys of the Mound Site excavation and treatment areas will be performed and the areas revegetated. Excavation and thermal desorption equipment will be decontaminated.

## **3 SITE CHARACTERIZATION**

### **3.1 Background**

The Mound Site is located north of Central Avenue, and east of the protected area (PA) fence. Approximately 1,405 intact drums were placed at the Mound Site between 1954 and 1958 and covered with soil. The drums contained uranium and beryllium-contaminated lathe coolant (a mixture of approximately 70 percent hydraulic oil and 30 percent carbon tetrachloride). Historical information also indicates that some of the coolant contained plutonium. In addition, some of the drums contained tetrachloroethylene (or perchloroethylene) (PCE).

In 1970 all drums were removed from the Mound Site along with some radiologically contaminated soil. Approximately 10 percent of the drums were thought to have holes at the time of removal. No airborne radiological contamination was detected during the drum removal. Recent characterization data indicates VOCs, predominantly PCE, have been detected in subsurface soils at levels requiring cleanup. Records, however, do not exist indicating the volume of contaminants released to the soils at the Mound Site.

Information on the Mound Site chemical and radiological contamination have been collected over many years and documented in various reports. These reports, referenced in the *Proposed Action Memorandum for the Source Removal at the Mound Site IHSS 113* (Ref. 4) were used to prepare this safety analysis.

### **3.2 Radionuclides in Soil**

Thirty-three samples have been collected from the Mound Site and analyzed for radionuclide content. The highest radiological concentration sample data, the mean concentration, and the 95% Upper Confidence Level (UCL) activity concentration from samples collected within the proposed Mound Site excavation area are provided in Table 3-1 (data from Ref. 4).

**Table 3-1 Concentration of Radionuclides**

<b>Radionuclide</b>	<b>Highest Concentration (pCi/g) (From borehole 14295 within the excavation area)</b>	<b>Mean Concentration (pCi/g) (From six boreholes within the excavation area)</b>	<b>95% UCL Concentration (pCi/g)</b>
Uranium 233/234	18 41	4 37	9 36
Uranium 235	1 38	0 33	0 73
Uranium 238	101 10	20 20	47 07
Americium 241	0 36	0 09	0 19
Plutonium 239/240	1 91	0 47	1 00

### 3 3 Volatile Organic Compounds in Soil

Several subsurface soil and water samples were taken at the Mound Site. Maximum concentrations of VOCs in soil or water are shown in Table 3-2.

**Table 3-2 Maximum Concentrations of VOC in Soil and Water Samples**

<b>Chemical Name</b>	<b>Concentration (ppm)</b>	<b>Location</b>
Carbon Tetrachloride	0 005	Borehole 14495
Methylene Chloride	19 0	Borehole 14295
Perchloroethylene (PCE)	760 0	Borehole 14295
Trichloroethylene (TCE)	18 0	Groundwater Well 0174

Borehole 14295 and 14495 locations are within the proposed Mound Site excavation area.

## 4 HAZARD ANALYSIS

### 4 1 Hazard Categorization Methodology - Radiological

The total activity of each identified radionuclide present at the Mound Site excavation, assumed to be the total 1,000 yd<sup>3</sup> that will be excavated and treated, was estimated using the formula below and the 95% UCL activity concentrations from Table 3-1. The total activity of each radionuclide was compared to the Category 3 thresholds in DOE-STD-1027-92. The ratio of the total activity to the 40 CFR 302 Appendix B Reportable Quantities (RQs) was then determined. Finally, the sum of these ratios was compared to unity to determine if the potentially releasable radiation from the Mound Site excavation exceeds the 40 CFR 302 notification requirements. Results of the calculations are provided in Table 4-1.

$$A_T = \text{Total Activity (pCi)} = A \times \rho \times V$$

$A$  = 95% UCL activity concentration pCi/g from Table 3.1

$\rho$  = soil density = 1.8 g/cm<sup>3</sup>

$V$  = soil volume excavated = 1,000 yd<sup>3</sup> = 27,000 ft<sup>3</sup>

The total activity for each isotope was calculated as follows

For U<sup>233</sup>/U<sup>234</sup>

$$A_T = 9.36 \text{ pCi/g} \times 1.8 \text{ g/cm}^3 \times 27,000 \text{ ft}^3 \times (1 \text{ cm}^3/3.53 \times 10^5 \text{ ft}^3)$$

$$A_T = 1.29 \times 10^{10} \text{ pCi} (\sim 0.013 \text{ Ci})$$

For U<sup>235</sup>

$$A_T = 0.73 \text{ pCi/g} \times 1.8 \text{ g/cm}^3 \times 27,000 \text{ ft}^3 \times (1 \text{ cm}^3/3.53 \times 10^5 \text{ ft}^3)$$

$$A_T = 1.01 \times 10^9 \text{ pCi} (\sim 0.001 \text{ Ci})$$

For U<sup>238</sup>

$$A_T = 47.07 \text{ pCi/g} \times 1.8 \text{ g/cm}^3 \times 27,000 \text{ ft}^3 \times (1 \text{ cm}^3/3.53 \times 10^5 \text{ ft}^3)$$

$$A_T = 6.48 \times 10^{10} \text{ pCi} (\sim 0.065 \text{ Ci})$$

For Am<sup>241</sup>

$$A_T = 0.19 \text{ pCi/g} \times 1.8 \text{ g/cm}^3 \times 27,000 \text{ ft}^3 \times (1 \text{ cm}^3/3.53 \times 10^5 \text{ ft}^3)$$

$$A_T = 2.62 \times 10^8 \text{ pCi} (\sim 0.00026 \text{ Ci})$$

For Pu<sup>239</sup>/Pu<sup>240</sup>

$$A_T = 1.00 \text{ pCi/g} \times 1.8 \text{ g/cm}^3 \times (1 \text{ cm}^3/3.53 \times 10^5 \text{ ft}^3) \times 27,000 \text{ ft}^3$$

$$A_T = 1.38 \times 10^9 \text{ pCi} (\sim 0.0014 \text{ Ci})$$

**Table 4-1 Radionuclide Quantities at Mound Site**

Radionuclide	Total Activity in 1,000 yd <sup>3</sup> of Soil, Ci	DOE-STD-1027, Attachment 1 Category 3 Thresholds, Ci	40 CFR 302.4 Appendix B RQ, Ci	Ratio (Activity/RQ)
Uranium 233/234	0.013	4.2	0.1	0.13
Uranium 235	0.001	4.2	0.1	0.01
Uranium 238	0.065	4.2	0.1	0.65
Americium 241	0.00026	0.52	0.01	0.026
Plutonium 239/240	0.0014	0.52	0.01	0.14
Total Sum-of-Ratios				0.956

## 4.2 Hazard Classification Methodology - Chemical

The total quantity of each identified chemical contaminant present at the Mound Site excavation, assumed to be the total 1,000 yd<sup>3</sup> that will be excavated and treated, was estimated using the formula below and the maximum detected concentrations from Table 3-2. The ratio of the individual concentration of each chemical to the 40 CFR 302 Appendix B Reportable Quantities (RQs) was then determined. Finally, the sum of these ratios was compared to unity to determine if the potentially releasable chemicals from the Mound Site excavation exceeds the 40 CFR 302 notification requirements. Results of the calculations are provided in Table 4-2.

$$Q = \text{quantity of chemical (mg)} = C \times \rho \times V$$

C = concentration mg/kg from Table 3-2

$\rho$  = soil density = 1.8 g/cm<sup>3</sup>

V = soil volume excavated = 1,000 yd<sup>3</sup> = 27,000 ft<sup>3</sup>

The total quantity for each chemical constituent was calculated as follows:

### For Carbon Tetrachloride

$$Q = 0.005 \text{ mg/kg} \times (1 \text{ kg}/1000 \text{ g}) \times 1.8 \text{ g/cm}^3 \times 27,000 \text{ ft}^3 \times (1 \text{ cm}^3/3.53 \times 10^{-5} \text{ ft}^3)$$

$$Q = 6.88 \times 10^3 \text{ mg } (\sim 0.0069 \text{ kg})$$

### Methylene Chloride

$$Q = 19.0 \text{ mg/kg} \times (1 \text{ kg}/1000 \text{ g}) \times 1.8 \text{ g/cm}^3 \times 27,000 \text{ ft}^3 \times (1 \text{ cm}^3/3.53 \times 10^{-5} \text{ ft}^3)$$

$$Q = 2.62 \times 10^7 \text{ mg } (\sim 26 \text{ kg})$$

### Perchloroethylene (PCE)

$$Q = 760.0 \text{ mg/kg} \times (1 \text{ kg}/1000 \text{ g}) \times 1.8 \text{ g/cm}^3 \times 27,000 \text{ ft}^3 \times (1 \text{ cm}^3/3.53 \times 10^{-5} \text{ ft}^3)$$

$$Q = 1.046 \times 10^9 \text{ mg } (\sim 1,050 \text{ kg})$$

### Trichloroethylene (TCE)

$$Q = 18.0 \text{ mg/kg} \times (1 \text{ kg}/1000 \text{ g}) \times 1.8 \text{ g/cm}^3 \times 27,000 \text{ ft}^3 \times (1 \text{ cm}^3/3.53 \times 10^{-5} \text{ ft}^3)$$

$$Q = 2.48 \times 10^7 \text{ mg } (\sim 25 \text{ kg})$$

Table 4-2 Chemical Quantities at Mound Site

Chemical	Quantity present in 1,000 yd <sup>3</sup> of Soil, kg	40 CFR 302.4 (RQ), kg	Ratio (Quantity/RQ)
Carbon Tetrachloride	0.0069	4.54	0.0015
Methylene Chloride	26	45.4	0.57
Perchloroethylene (PCE)	1,050	45.4	23
Trichloroethylene (TCE)	25	45.4	0.55
Total Sum-of-Ratios			24.12



### 4.3 Final Hazard Categorization

Based on the guidance in DOE-STD-5502-94 the Mound Site (source removal activities) is classified as "low hazard non-nuclear" requiring compliance with applicable OSHA Standards preparation of a site specific Health and Safety Plan (HASP), and preparation of an "auditable safety analysis." This classification was determined as follows:

- Potentially releasable radiation does not meet or exceed DOE-STD-1027, Attachment 1 thresholds (see Table 4-1), and
- Potentially releasable radiation RQ does not meet or exceed 40 CFR 302, Appendix B levels (see Table 4-1), and
- Potentially releasable hazardous chemical RQ exceeds 40 CFR 302, Table 40 CFR 302 levels (see Table 4-2)

This safety analysis serves as the "auditable safety analysis" required to meet DOE-STD-5502-94. The Mound Site-specific HASP (1) provides systematic identification of hazards within the source removal activities, (2) describes and analyzes the adequacy of the measures taken to eliminate, control, or mitigate identified hazards, and (3) analyzes and evaluates potential accidents.

### 4.4 Hazard Analysis Results

Based on the "low hazard non-nuclear" hazard classification determination, the radiological hazards associated with the Mound Site source removal activities present negligible offsite impacts to people and the environment. Therefore, no radiological accident scenarios resulting in the release of radionuclides have been analyzed in this safety analysis.

For chemicals, the amount present in the total quantity of soils that will be excavated and treated exceeds the 40 CFR 302 levels. However, the amount that evaporates from the soil as it is handled should be negligible compared to these levels. The potential for release of VOCs during thermal desorption will be adequately controlled by treatment unit design (i.e., capture of off-gases, air monitoring for VOCs, HEPA filtration to minimize particulate emissions). Therefore, no accident scenarios resulting in the release of chemicals have been analyzed in this safety analysis.

Occupational hazards, including common industrial hazards (chemical exposures, biological hazards, and physical hazards), are identified and evaluated in the site-specific HASP (Ref. 2) and are clearly regulated by DOE-prescribed occupational safety and health standards. No specific analysis was performed for these types of hazards as part of this safety analysis.

## 5 HAZARD CONTROLS

Controls for onsite radiological, chemical, biological, and physical hazards associated with source removal activities at the Mound Site are prescribed in the site-specific HASP. No additional controls, beyond what is documented in the HASP, are necessary to control negligible offsite radiological and chemical hazards. Offsite impacts will be adequately controlled provided that the controls identified in the HASP are implemented and maintained.

## 6 REFERENCES

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- 1 *Final Rocky Flats Cleanup Agreement (RFCA)* DOE, Rocky Flats environmental Technology Site 1996
- 2 *Draft Site Specific Health and Safety Plan for the Source Removal at the Mound Site IHSS 113 RF/RMRS-96-0061* Rocky Mountain Remediation Services LLC January 1997
- 3 *Proposed Action Memorandum for the Source Removal at the Mound Site IHSS 113 RF/RMRS-96-0059*, Rocky Mountain Remediation Services, LLC December 16 1996
- 4 *Hazard Baseline Documentation DOE Limited Standard 5502-94* U S Department of Energy Washington D C August 1994
- 5 *Hazardous Waste Operations and Emergency Response, Code of Federal Regulations, 29 CFR 1926 65*, Department of Labor Occupational Safety and Health Administration, Washington D C
- 6 *Nuclear Safety Analysis Reports DOE Order 5480 23*, U S Department of Energy Washington D C April 30 1992
- 7 *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480 23 Nuclear Safety Analysis Reports, DOE Standard 1027-92*, U S Department of Energy Washington D C December 1992
- 8 *Process Safety Management, Code of Federal Regulations, 29 CFR 1910.119*, Department of Labor Occupational Safety and Health Administration, Washington D C
- 9 *Risk Management Programs (RMP) for Chemical Accidental Release Prevention, Code of Federal Regulations, 40 CFR 68* Office of the Federal Register Washington D C.
- 10 *Designation Reportable Quantities, and Notification Code of Federal Regulations, 40 CFR 302* Office of the Federal Register Washington D C
- 11 *RFETS Radiological Controls Manual, Kaiser-Hill*, Rocky Flats environmental Technology Site 1996

**MOUND SITE SOURCE REMOVAL  
SITE PREPARATION AT THE MOUND SITE  
(Culvert Installation and Road Upgrade)**

**Activity Hazard Analysis**

**1-28-97**

Activity	Hazard	Preventative Measures
All site activities	General work hazards	All personnel will wear steel toed shoes, safety glasses with side shields, hard hats, reflective vests, and hearing protection as applicable in the support zone
	Heat stress	Heat stress monitoring will be conducted in regards to work load and PPE worn
	Cold stress	Cold stress monitoring will be conducted Proper clothing will be available to all personnel and administrative controls will be adhered to
	Noise	Noise monitoring will be conducted Where necessary personnel will wear hearing protection In addition, all personnel will participate in the RFETS Hearing Conservation Program if necessary
Traversing the site	Slip, trips, falls	Care will be taken when traversing the site especially when carrying equipment All trip hazards will be immediately removed or marked when identified
Lifting equipment and materials	Back injury	Proper lifting techniques will be used and heavy equipment, where feasible, will be utilized to move heavy loads
Handling equipment and materials	Pinch points and sharp edges	Care will be taken when pinch points and sharp edges exist and heavy duty leather work gloves will be worn

Activity	Hazard	Preventative Measures
Using hand tools	Hand tools in unsafe operating condition	Hand tools will be inspected by the user prior to each use
	Improper use of hand tools	Hand tools will be utilized for their intended use and operated in accordance with HSP-12 10 Guards will be in place and no modifications will be made
	Electrical shock	Portable power tools will be plugged into a GFCI protected outlet and will be UL listed and double insulated Cords will be inspected by the user and protected from unnecessary damage Any tool whose cord shows signs of damage or deterioration will be immediately removed from service
Use of generators	Electrical shock	Extension cords will be intended for outdoor use, inspected by the user, and protected from unnecessary damage Any extension cords which show signs of damage or deterioration will be immediately removed from service
	Electrical shock	Cords will be plugged into a GFCI protected outlet and the generator will be properly grounded The GFCI will be tested by the user daily prior to the beginning of each shift
	Fire	At a minimum a 10 lb ABC fire extinguisher will be located in the work area and next to the generator All refueling will be conducted at the beginning of the shift when the generators are cool
	Use of gasoline	Follow recommendations on MSDS (see Appendix C)

Activity	Hazard	Preventative Measures
<p>Excavating bottom of Central Avenue ditch</p> <p>Removing vegetative soil, scarifying, backfilling, and compacting soil</p> <p>Minor road improvements including placing road base, grading, and compacting</p>	Heavy equipment in poor operating condition	Heavy equipment will be inspected prior to entering RFETS. The operators will inspect and document heavy equipment prior to the beginning of each shift.
	Improper operation of heavy equipment	Personnel will be properly trained in the use and limitations of all heavy equipment.
	Ground personnel being struck with heavy equipment or falling loads	Ground personnel will wear orange vests, stay at least 20' away from heavy equipment, and maintain line of sight with the operators.
	Other equipment being struck with heavy equipment	Heavy equipment operations will be conducted in a deliberate safe manner. A spotter will be required when backing heavy equipment.
	Vehicular traffic	In addition to orange vests, a flagperson will be assigned to control traffic when working on or near the active roadway.
Installation of culvert	Crushing	Culvert sections will be blocked or otherwise secured prior to personnel working or standing in its path of travel.
Use of nuclear soil density gauge	Improper use or handling resulting in exposure to the internal radioactive sources	Certifications for the operator and the gauge will be on site at all times. The gauge will be used and transported in accordance with manufacturers specifications and HSP-18.04.
Mixing and applying ConCover®	Inhalation of silica	A full-facepiece air-purifying respirator will be worn when mixing the ConCover®. Respirator wearers will be medically cleared, trained, and fit to the respirator being worn. Personnel not wearing respirators will stay at least 20' away from mixing operations.


Activity	Hazard	Preventative Measures
Mixing and applying ConCover® (cont )	Contact with mixing blades	Personnel will not reach into the machine at any time
	Injury from high pressure spray	At no time will the nozzle be pointed at any body part or other personnel
	Falls from the unit during transport	Operators will ride only in the approved area while in transport and the restraint devices will be in place
Spraying water for dust control	Pump malfunction or hose rupture	Pumps and hoses will be inspected by the user prior to use The hoses will be protected from unnecessary damage

Approved

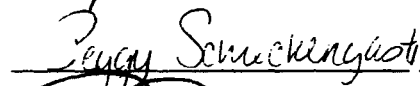
Signature

Date

RMRS Project Manager-Wayne Sproles

 4-2-97

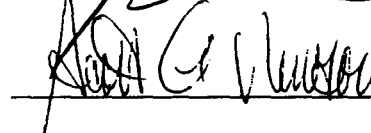
RMRS H&amp;S Supervisor-Peggy Schreckengast

 4-2-97

RMRS Radiological Coordinator-Jerry Anderson

 4/2/97

SSOC Radiological Engineer-Scott Newsom

 4/2/97

**MOUND SITE SOURCE REMOVAL**  
**SITE PREPARATION AT THE MOUND SITE AND THE CSFS AREA**

(Establishment of Equipment Infrastructure)

**Activity Hazard Analysis**

1-28-97

Activity	Hazard	Preventative Measures
All site activities	General work hazards	All personnel will wear steel toed shoes, safety glasses with side shields, hard hats, reflective vests, and hearing protection as applicable in the support zone
	Heat stress	Heat stress monitoring will be conducted in regards to work load and PPE worn
	Cold stress	Cold stress monitoring will be conducted Proper clothing will be available to all personnel and administrative controls will be adhered to
	Noise	Noise monitoring will be conducted Where necessary personnel will wear hearing protection In addition, all personnel will participate in the RFETS Hearing Conservation Program if necessary
Traversing the site	Slip, trips, falls	Care will be taken when traversing the site especially when carrying equipment All trip hazards will be immediately removed or marked when identified
Lifting equipment and materials	Back injury	Proper lifting techniques will be used and heavy equipment, where feasible, will be utilized to move heavy loads
Handling equipment and materials	Pinch points and sharp edges	Care will be taken when pinch points and sharp edges exist and heavy duty leather work gloves will be worn

Activity	Hazard	Preventative Measures
Using hand tools to build secondary containment	Hand tools in unsafe operating condition	Hand tools will be inspected by the user prior to each use
	Improper use of hand tools	Hand tools will be utilized for their intended use and operated in accordance with HSP-12 10 Guards will be in place and no modifications will be made
	Electrical shock	Portable power tools will be plugged into a GFCI protected outlet and will be UL listed and double insulated Cords will be inspected by the user and protected from unnecessary damage Any tool whose cord shows signs of damage or deterioration will be immediately removed from service
Use of generators to power portable power tools	Electrical shock	Extension cords will be intended for outdoor use, inspected by the user, and protected from unnecessary damage Any extension cords which show signs of damage or deterioration will be immediately removed from service
	Electrical shock	Cords will be plugged into a GFCI protected outlet and the generator will be properly grounded The GFCI will be tested by the user daily prior to the beginning of each shift
	Fire	At a minimum, a 10 lb ABC fire extinguisher will be located in the work area and next to the generator All refueling will be conducted at the beginning of the shift when the generators are cool
	Use of gasoline	Follow recommendations on MSDS (see Appendix C)



Activity	Hazard	Preventative Measures
Using fork truck to locate poly tanks, pumps, generators, and jersey barriers	Fork truck in poor operating condition	The operator will inspect and document the fork truck prior to the beginning of each shift
	Improper operation of fork truck	Operators will hold a current Fork Truck Operator Permit and all operations will be in accordance with HSP-9 06
	Ground personnel being struck with fork truck	Ground personnel will wear orange vests and maintain line of sight with the fork truck operator
	Other equipment being struck with fork truck	Fork truck operations will be conducted in a deliberate safe manner A spotter will be required when backing the fork truck
	Injury resulting from unsecured loads	Loads will be secured Jersey barriers will be moved with the forks in the lowest possible position and personnel will stay back a minimum of ten feet
Driving fence posts, ground rods, or equipment hold downs	Pinch points	Pay particular attention to pinch points when using pneumatic/hydraulic or slide type driving devices
	Ear injury	Hearing protection will be worn
Placement of Jersey barriers with loader	Dropping load	Front end loader has capacity using inspected cable

**Approved**

**Signature**

**Date**

RMRS Project Manager-Wayne Sproles

Wayne Sproles 1 4-2-97

RMRS H&S Supervisor-Peggy Schreckengast

Peggy Schreckengast 1 4-2-97

RMRS Radiological Coordinator-Jerry Anderson

[Signature] 1 4/2/97

SSOC Radiological Engineer-Scott Newsom

Scott Newsom 1 4/2/97

**MOUND SITE SOURCE REMOVAL**  
**INSTALLING STORMWATER DITCH AND REMOVING TOPSOIL AT THE CSFS**

**Activity Hazard Analysis**

**1-28-97**

Activity	Hazard	Preventative Measures
All site activities	General work hazards	All personnel will wear steel toed shoes, safety glasses with side shields, hard hats, reflective vests, and hearing protection as applicable in the support zone
	Heat stress	Heat stress monitoring will be conducted in regards to work load and PPE worn
	Cold stress	Cold stress monitoring will be conducted Proper clothing will be available to all personnel and administrative controls will be adhered to
	Noise	Noise monitoring will be conducted Where necessary personnel will wear hearing protection In addition, all personnel will participate in the RFETS Hearing Conservation Program if necessary
Traversing the site	Slip, trips, falls	Care will be taken when traversing the site especially when carrying equipment All trip hazards will be immediately removed or marked when identified
Lifting equipment and materials	Back injury	Proper lifting techniques will be used and heavy equipment, where feasible, will be utilized to move heavy loads
Handling equipment and materials	Pinch points and sharp edges	Care will be taken when pinch points and sharp edges exist and heavy duty leather work gloves will be worn

Activity	Hazard	Preventative Measures
Using hand tools	Hand tools in unsafe operating condition	Hand tools will be inspected by the user prior to each use
	Improper use of hand tools	Hand tools will be utilized for their intended use and operated in accordance with HSP-12 10 Guards will be in place and no modifications will be made
	Electrical shock	Portable power tools will be plugged into a GFCI protected outlet and will be UL listed and double insulated Cords will be inspected by the user and protected from unnecessary damage Any tool whose cord shows signs of damage or deterioration will be immediately removed from service
Use of generators	Electrical shock	Extension cords will be intended for outdoor use, inspected by the user, and protected from unnecessary damage Any extension cords which show signs of damage or deterioration will be immediately removed from service
	Electrical shock	Cords will be plugged into a GFCI protected outlet and the generator will be properly grounded The GFCI will be tested by the user daily prior to the beginning of each shift
	Fire	At a minimum, a 10 lb ABC fire extinguisher will be located in the work area and next to the generator All refueling will be conducted at the beginning of the shift when the generators are cool
	Use of gasoline	Follow recommendations on MSDS (see Appendix C)

Activity	Hazard	Preventative Measures
Install stormwater collection ditch and remove topsoil from the CSFS	Heavy equipment in poor operating condition	Heavy equipment will be inspected prior to entering RFETS. The operator will inspect and document heavy equipment prior to the beginning of each shift.
	Improper operation of heavy equipment	Operators will be properly trained in the use and limitations of all heavy equipment.
	Ground personnel being struck with heavy equipment or falling loads	Ground personnel will wear orange vests, stay at least 20' away from heavy equipment, and maintain line of sight with the operators.
	Other equipment being struck with heavy equipment	Heavy equipment operations will be conducted in a deliberate safe manner. A spotter will be required when backing heavy equipment.
	Skin exposure to radionuclides in soil	Personnel in the EZ/SCA will wear modified level D PPE and limit contact with contaminated soil.
	Inhalation of radionuclides	High volume air sampling will be conducted in the work area.
Mixing and applying ConCover®	Inhalation of silica	A full-facepiece air-purifying respirator will be worn when mixing the ConCover®. Respirator wearers will be medically cleared, trained, and fit to the respirator being worn. Personnel not wearing respirators will stay at least 20' away from mixing operations.
	Contact with mixing blades	Personnel will not reach into the machine at any time.
	Injury from high pressure spray	At no time will the nozzle be pointed at any body part or other personnel.
	Falls from the unit during transport	Operators will ride only in the approved area while in transport and the restraint devices will be in place.


Activity	Hazard	Preventative Measures
Spraying water for dust control	Pump malfunction or hose rupture	Pumps and hoses will be inspected by the user prior to use The hoses will be protected from unnecessary damage

Approved

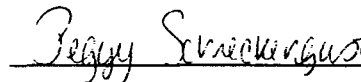
Signature

Date


RMRS Project Manager-Wayne Sproles

 4-2-97


RMRS H&amp;S Supervisor-Peggy Schreckengast

 4-2-97

RMRS Radiological Coordinator-Jerry Anderson

 4/2/97

SSOC Radiological Engineer-Scott Newsom

 4/2/97

**MOUND SITE SOURCE REMOVAL  
EXCAVATION OF CONTAMINATED SOIL**

**Activity Hazard Analysis**

1-28-97

Activity	Hazard	Preventative Measures
All site activities	General work hazards	All personnel will wear steel toed shoes, safety glasses with side shields, hard hats, reflective vests, and hearing protection as applicable in the support zone
	Heat stress	Heat stress monitoring will be conducted in regards to work load and PPE worn
	Cold stress	Cold stress monitoring will be conducted Proper clothing will be available to all personnel and administrative controls will be adhered to
	Noise	Noise monitoring will be conducted Where necessary personnel will wear hearing protection In addition, all personnel will participate in the RFETS Hearing Conservation Program if necessary
Traversing the site	Slip, trips, falls	Care will be taken when traversing the site especially when wearing PPE and carrying equipment All trip hazards will be immediately removed or marked when identified
Lifting equipment and materials	Back injury	Proper lifting techniques will be used and heavy equipment, where feasible, will be utilized to move heavy loads
Handling equipment and materials	Pinch points and sharp edges	Care will be taken when pinch points and sharp edges exist and heavy duty leather work gloves will be worn

Activity	Hazard	Preventative Measures
Using hand tools	Hand tools in unsafe operating condition	Hand tools will be inspected by the user prior to each use
	Improper use of hand tools	Hand tools will be utilized for their intended use and operated in accordance with HSP-12 10 Guards will be in place and no modifications will be made
	Electrical shock	Portable power tools will be plugged into a GFCI protected outlet and will be UL listed and double insulated Cords will be inspected by the user and protected from unnecessary damage Any tool whose cord shows signs of damage or deterioration will be immediately removed from service
Use of generators	Electrical shock	Extension cords will be intended for outdoor use, inspected by the user, and protected from unnecessary damage Any extension cords which show signs of damage or deterioration will be immediately removed from service
	Electrical shock	Cords will be plugged into a GFCI protected outlet and the generator will be properly grounded The GFCI will be tested by the user daily prior to the beginning of each shift
	Fire	At a minimum a 10 lb ABC fire extinguisher will be located in the work area and next to the generator All refueling will be conducted at the beginning of the shift when the generators are cool
	Use of gasoline	Follow recommendations on MSDS (see Appendix C)



Activity	Hazard	Preventative Measures
Trackhoe operation	Trackhoe in poor operating condition	The trackhoe will be inspected prior to entering RFETS. The operator will inspect and document the trackhoe prior to the beginning of each shift.
	Improper operation of the trackhoe	Operators will be properly trained in the use and limitations of the trackhoe.
	Ground personnel being struck with trackhoe or falling loads	Ground personnel will wear orange vests, stay at least 20' away from the trackhoe, and maintain line of sight with the operator.
	Other equipment being struck with trackhoe	The forty ton dump truck will be stationary with the parking brake set prior to loading of soil. Trackhoe operations will be conducted in a deliberate safe manner. A spotter will be required when backing the trackhoe.
Use of Level B respiratory protection	Physical fatigue	Medical approval will be required for personnel.
	Improper face to facepiece seal	Respirator specific fit test approval will be required for personnel.
	Improper inspection or use of respirator	Personnel will be trained in the inspection, use, and limitations of the specific respirator worn.
	Unsecured airline bottles on trackhoe	Airline bottles will be inspected by the user prior to and during each shift.
Excavating contaminated soil	Skin exposure to volatile organic compounds	Personnel in the EZ/SCA will wear Level B PPE and limit contact with contaminated soil.
	Inhalation of volatile organic compounds	Personnel in the EZ/SCA will wear Level B respiratory protection CRZ/RBA and support zone work controls will be based on perimeter real-time VOC monitoring.

Activity	Hazard	Preventative Measures
Excavating contaminated soil (cont )	Skin exposure to radionuclides in soil	Personnel in the EZ/SCA will wear Level B PPE and limit contact with contaminated soil
	Inhalation of radionuclides	Personnel in the EZ/SCA will wear Level B respiratory protection CRZ/RBA and support zone work controls will be based on perimeter air monitoring
Working around open trench	Slips, trips, falls into trench	Personnel will stay a minimum of six feet away from the edge of the trench Personnel closer than six feet must wear a full body harness and lifeline attached to an approved anchorage point
	Sloughing of trench walls	The trench will be inspected prior to and during each shift
	Equipment falling into trench	All equipment, except the excavator, will be kept a minimum of six feet away from the edge of the trench
Obtaining FIDLER readings at the trackhoe bucket	Ground personnel being struck with trackhoe	Prior to the RCT approaching the bucket the operator will set the bucket on the ground, disengage the hydraulic system, set the parking brake, and give a hand signal indicating that the RCT may approach
Spraying water for dust control and pumping decontamination or incidental water into the holding tanks or into tanker trucks	Pump malfunction or hose rupture	Pumps and hoses will be inspected by the user prior to use The hoses will be protected from unnecessary damage The discharge end of the incidental water hose will be submerged in the holding tank Tankers will be filled in accordance with their safety guidelines

**Approved**

**Signature**

**Date**

RMRS Project Manager-Wayne Sproles

Wayne Sproles , 4-2-97

RMRS H&S Supervisor-Peggy Schreckengast

Peggy Schreckengast , 4-2-97

RMRS Radiological Coordinator-Jerry Anderson

[Signature] , 4/2/97

SSOC Radiological Engineer-Scott Newsom

Scott A. Newsom , 4/2/97

**MOUND SITE SOURCE REMOVAL  
TRANSPORT AND DUMPING OF CONTAMINATED SOIL**

**Activity Hazard Analysis**

**1-28-97**

Activity	Hazard	Preventative Measures
All site activities	General work hazards	All personnel will wear steel toed shoes, safety glasses with side shields, hard hats, reflective vests, and hearing protection as applicable in the support zone
	Heat stress	Heat stress monitoring will be conducted in regards to work load and PPE worn
	Cold stress	Cold stress monitoring will be conducted Proper clothing will be available to all personnel and administrative controls will be adhered to
	Noise	Noise monitoring will be conducted Where necessary personnel will wear hearing protection In addition, all personnel will participate in the RFETS Hearing Conservation Program if necessary
Traversing the site	Slip, trips falls	Care will be taken when traversing the site especially when wearing PPE and carrying equipment All trip hazards will be immediately removed or marked when identified
Lifting equipment and materials	Back injury	Proper lifting techniques will be used and heavy equipment, where feasible will be utilized to move heavy loads
Handling equipment and materials	Pinch points and sharp edges	Care will be taken when pinch points and sharp edges exist and heavy duty leather work gloves will be worn

Activity	Hazard	Preventative Measures
Using hand tools	Hand tools in unsafe operating condition	Hand tools will be inspected by the user prior to each use
	Improper use of hand tools	Hand tools will be utilized for their intended use and operated in accordance with HSP-12 10 Guards will be in place and no modifications will be made.
	Electrical shock	Portable power tools will be plugged into a GFCI protected outlet and will be UL listed and double insulated Cords will be inspected by the user and protected from unnecessary damage Any tool whose cord shows signs of damage or deterioration will be immediately removed from service
Use of generators	Electrical shock	Extension cords will be intended for outdoor use, inspected by the user, and protected from unnecessary damage Any extension cords which show signs of damage or deterioration will be immediately removed from service
	Electrical shock	Cords will be plugged into a GFCI protected outlet and the generator will be properly grounded The GFCI will be tested by the user daily prior to the beginning of each shift
	Fire	At a minimum, a 10 lb ABC fire extinguisher will be located in the work area and next to the generator All refueling will be conducted at the beginning of the shift when the generators are cool
	Use of gasoline	Follow recommendations on MSDS (see Appendix C)

Activity	Hazard	Preventative Measures
Articulated dump truck operation	Dump truck in poor operating condition	The dump truck will be inspected prior to entering RFETS. The operator will inspect and document the dump truck prior to the beginning of each shift.
	Improper operation of the dump truck	Personnel will be properly trained in the use and limitations of the dump truck.
	Ground personnel being struck with dump truck	Ground personnel will wear orange vests, stay at least 20 feet away from the dump truck, and maintain line of sight with the operator.
	Vehicular traffic being struck with dump truck	Prior to movement, the flagpersons will confirm that they are in position, all traffic is stopped, and the path of travel is clear.
	Other equipment being struck with dump truck	Dump truck operations will be conducted in a deliberate safe manner. A spotter will be required when backing the dump truck.
	Spills or dust generation during transport	A one foot freeboard will be maintained at all times. Water will be sprayed on the load prior to transport and speed will be limited to 5 mph. Direct observation will ensure prompt response should a spill or dust generation occur.
Use of Level B respiratory protection	Physical fatigue	Medical approval will be required for personnel.
	Improper face to facepiece seal	Respirator specific fit test approval will be required for personnel.
	Improper inspection or use of respirator	Personnel will be trained in the inspection, use, and limitations of the specific respirator worn.
	Unsecured airline bottles on dump truck	Airline bottles will be inspected by the user prior to and during each shift.

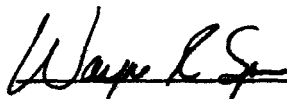
Activity	Hazard	Preventative Measures
Dumping contaminated soil	Skin exposure to volatile organic compounds	Personnel in the EZ/SCA will wear Level B PPE and limit contact with contaminated soil
	Inhalation of volatile organic compounds	Personnel in the EZ/SCA will wear Level B respiratory protection CRZ/RBA and support zone work controls will be based on perimeter real-time VOC monitoring
	Skin exposure to radionuclides in soil	Personnel in the EZ/SCA will wear Level B PPE and limit contact with contaminated soil
	Inhalation of radionuclides	Personnel in the EZ/SCA will wear Level B respiratory protection CRZ/RBA and support zone work controls will be based on perimeter air monitoring
	Ground personnel being engulfed by dumped soil	Ground personnel will stay at least 50' from the dump truck and the operator will not dump the load until given a visual hand signal from the spotter
Spraying water for dust control	Pump malfunction or hose rupture	Pumps and hoses will be inspected by the user prior to use The hoses will be protected from unnecessary damage

Approved

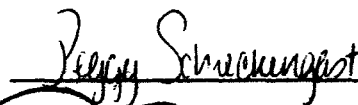
Signature

Date

RMRS Project Manager-Wayne Sproles

 4-2-97

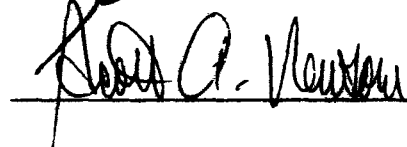
RMRS H&amp;S Supervisor-Peggy Schreckengast

 4/2/97

RMRS Radiological Coordinator-Jerry Anderson

 4/2/97

SSOC Radiological Engineer-Scott Newsom

 4/2/97

**MOUND SITE SOURCE REMOVAL  
MANAGEMENT OF CONTAMINATED SOIL FEED STOCKPILE**

**Activity Hazard Analysis**

1-28-97

Activity	Hazard	Preventative Measures
All site activities	General work hazards	All personnel will wear steel toed shoes, safety glasses with side shields, hard hats, reflective vests, and hearing protection as applicable in the support zone
	Heat stress	Heat stress monitoring will be conducted in regards to work load and PPE worn
	Cold stress	Cold stress monitoring will be conducted Proper clothing will be available to all personnel and administrative controls will be adhered to
	Noise	Noise monitoring will be conducted Where necessary personnel will wear hearing protection In addition, all personnel will participate in the RFETS Hearing Conservation Program if necessary
Traversing the site	Slip, trips, falls	Care will be taken when traversing the site especially when wearing PPE and carrying equipment All trip hazards will be immediately removed or marked when identified
Lifting equipment and materials	Back injury	Proper lifting techniques will be used and heavy equipment, where feasible, will be utilized to move heavy loads
Handling equipment and materials	Pinch points and sharp edges	Care will be taken when pinch points and sharp edges exist and heavy duty leather work gloves will be worn



Activity	Hazard	Preventative Measures
Using hand tools	Hand tools in unsafe operating condition	Hand tools will be inspected by the user prior to each use
	Improper use of hand tools	Hand tools will be utilized for their intended use and operated in accordance with HSP-12 10 Guards will be in place and no modifications will be made
	Electrical shock	Portable power tools will be plugged into a GFCI protected outlet and will be UL listed and double insulated Cords will be inspected by the user and protected from unnecessary damage Any tool whose cord shows signs of damage or deterioration will be immediately removed from service
Use of generators	Electrical shock	Extension cords will be intended for outdoor use, inspected by the user, and protected from unnecessary damage Any extension cords which show signs of damage or deterioration will be immediately removed from service
	Electrical shock	Cords will be plugged into a GFCI protected outlet and the generator will be properly grounded The GFCI will be tested by the user daily prior to the beginning of each shift
	Fire	At a minimum, a 10 lb ABC fire extinguisher will be located in the work area and next to the generator All refueling will be conducted at the beginning of the shift when the generators are cool
	Use of gasoline	Follow recommendations on MSDS (see Appendix C)

Activity	Hazard	Preventative Measures
Front end loader operation	Front end loader in poor operating condition	The front end loader will be inspected prior to entering the site The operator will inspect and document the front end loader prior to the beginning of each shift
	Improper operation of the front end loader	Operators will be properly trained in the use and limitations of the front end loader
	Ground personnel being struck with front end loader or falling loads	Personnel will wear orange vests, stay at least 20 away from the front end loader, and maintain line of sight with the operator
	Other equipment being struck with front end loader	Front end loader operations will be conducted in a deliberate safe manner A spotter will be required when backing the front end loader
Use of Level B respiratory protection	Physical fatigue	Medical approval will be required for personnel
	Improper face to facepiece seal	Respirator specific fit test approval will be required for personnel
	Improper inspection or use of respirator	Personnel will be trained in the inspection, use, and limitations of the specific respirator worn
	Unsecured airline bottles on front end loader	Airline bottles will be inspected by the user prior to and during each shift
Moving contaminated soil	Skin exposure to volatile organic compounds	Personnel in the EZ/SCA will wear Level B PPE and limit contact with contaminated soil
	Inhalation of volatile organic compounds	Personnel in the EZ/SCA will wear Level B respiratory protection CRZ/RBA and support zone work controls will be based on perimeter real-time VOC monitoring
	Skin exposure to radionuclides in soil	Personnel in the EZ/SCA will wear Level B PPE and limit contact with contaminated soil


Activity	Hazard	Preventative Measures
Moving contaminated soil (cont )	Inhalation of radionuclides	Personnel in the EZ/SCA will wear Level B respiratory protection CRZ/RBA and support zone work controls will be based on perimeter air monitoring
Spraying water for dust control and pumping decontamination or incidental water into the holding tanks or into tanker trucks	Pump malfunction or hose rupture	Pumps and hoses will be inspected by the user prior to use The hose will be protected from unnecessary damage The discharge end of the incidental water hose will be submerged in the holding tank Tankers will be filled in accordance with their safety guidelines
Covering stockpile with tarpaulin	Slips, trips, falls, and back injury	Use front end loader to pull tarp if feasible Use a many people as possible to move tarp Do not attempt to cover stockpile alone

Approved

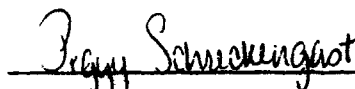
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Date


RMRS Project Manager-Wayne Sproles

 4-2-97

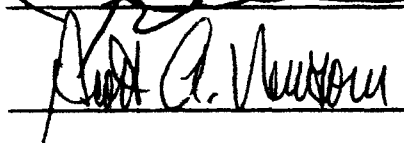
RMRS H&amp;S Supervisor-Peggy Schreckengast

 4/2/97

RMRS Radiological Coordinator-Jerry Anderson

 4/2/97

SSOC Radiological Engineer-Scott Newsom

 4/2/97

**MOUND SITE SOURCE REMOVAL  
EXCAVATION VERIFICATION SAMPLING**

**Activity Hazard Analysis**

**1-28-97**

Activity	Hazard	Preventative Measures
All site activities	General work hazards	All personnel will wear steel toed shoes, safety glasses with side shields, hard hats, reflective vests, and hearing protection as applicable in the support zone
	Heat stress	Heat stress monitoring will be conducted in regards to work load and PPE worn
	Cold stress	Cold stress monitoring will be conducted Proper clothing will be available to all personnel and administrative controls will be adhered to
	Noise	Noise monitoring will be conducted Where necessary personnel will wear hearing protection In addition, all personnel will participate in the RFETS Hearing Conservation Program if necessary
Traversing the site	Slip, trips falls	Care will be taken when traversing the site especially when wearing PPE and carrying equipment All trip hazards will be immediately removed or marked when identified
Lifting equipment and materials	Back injury	Proper lifting techniques will be used and heavy equipment, where feasible, will be utilized to move heavy loads
Handling equipment and materials	Pinch points and sharp edges	Care will be taken when pinch points and sharp edges exist and heavy duty leather work gloves will be worn

Activity	Hazard	Preventative Measures
Using hand tools	Hand tools in unsafe operating condition	Hand tools will be inspected by the user prior to each use
	Improper use of hand tools	Hand tools will be utilized for their intended use and operated in accordance with HSP-12 10 Guards will be in place and no modifications will be made
	Electrical shock	Portable power tools will be plugged into a GFCI protected outlet and will be UL listed and double insulated Cords will be inspected by the user and protected from unnecessary damage Any tool whose cord shows signs of damage or deterioration will be immediately removed from service
Use of generators	Electrical shock	Extension cords will be intended for outdoor use, inspected by the user, and protected from unnecessary damage Any extension cords which show signs of damage or deterioration will be immediately removed from service
	Electrical shock	Cords will be plugged into a GFCI protected outlet and the generator will be properly grounded The GFCI will be tested by the user daily prior to the beginning of each shift
	Fire	At a minimum, a 10 lb ABC fire extinguisher will be located in the work area and next to the generator All refueling will be conducted at the beginning of the shift when the generators are cool
	Use of gasoline	Follow recommendations on MSDS (see Appendix C)

Activity	Hazard	Preventative Measures
Trackhoe operation	Trackhoe in poor operating condition	The trackhoe will be inspected prior to entering RFETS. The operator will inspect and document the trackhoe prior to the beginning of each shift.
	Improper operation of the trackhoe	Operators will be properly trained in the use and limitations of the trackhoe.
	Ground personnel being struck with trackhoe or falling loads	Ground personnel will wear orange vests, stay at least 20' away from the trackhoe, and maintain line of sight with the operator.
	Other equipment being struck with trackhoe	Trackhoe operations will be conducted in a deliberate safe manner. A spotter will be required when backing the trackhoe.
Use of Level B respiratory protection	Physical fatigue	Medical approval will be required for personnel.
	Improper face to facepiece seal	Respirator specific fit test approval will be required for personnel.
	Improper inspection or use of respirator	Personnel will be trained in the inspection procedures, use, and limitations of the specific respirator worn.
	Unsecured airline bottles on trackhoe	Airline bottles will be inspected by the user prior to and during each shift.
Decontamination of trackhoe bucket	Ground personnel being struck with trackhoe	Prior to personnel approaching the bucket, the trackhoe operator will set the bucket on the ground, disengage the hydraulic system, set the parking brake, turn the engine off, and give a hand signal indicating that personnel may approach.
	Skin contact with decontamination fluids	Depending on the type of decontamination, polycoated Tyvek® will be worn.

Activity	Hazard	Preventative Measures
Excavating soil to be sampled	Skin exposure to volatile organic compounds	Personnel in the EZ/SCA will wear Level B PPE and limit contact with contaminated soil
	Inhalation of volatile organic compounds	Personnel in the EZ/SCA will wear Level B respiratory protection CRZ/RBA and support zone work controls will be based on perimeter real-time VOC monitoring
	Skin exposure to radionuclides in soil	Personnel in the EZ/SCA will wear Level B PPE and limit contact with contaminated soil
	Inhalation of radionuclides	Personnel in the EZ/SCA will wear Level B respiratory protection CRZ/RBA and support zone work controls will be based on perimeter air monitoring
Working around open trench	Slips, trips, falls into trench	Personnel will stay a minimum of six feet away from the edge of the trench. Personnel closer than six feet must wear a full body harness and lifeline attached to an approved anchorage point
	Sloughing of trench walls	The trench will be inspected prior to and during each shift
	Equipment falling into trench	All equipment, except the excavator, will be kept a minimum of six feet away from the edge of the trench
Obtaining FIDLER readings and samples at the trackhoe bucket	Ground personnel being struck with trackhoe	Prior to the RCT and samplers approaching the bucket, the trackhoe operator will set the bucket on the ground, disengage the hydraulic system, set the parking brake, and give a hand signal indicating that the RCT and the sampler may approach
Spraying water for dust control	Pump malfunction or hose rupture	Pumps and hoses will be inspected by the user prior to use. The hoses will be protected from unnecessary damage

**Approved**

**Signature**

**Date**

RMRS Project Manager-Wayne Sproles

Wayne R Sproles 1 4-2-97

RMRS H&S Supervisor-Peggy Schreckengast

Peggy Schreckengast 1 4-2-97

RMRS Radiological Coordinator-Jerry Anderson

[Signature] 4/2/97

SSOC Radiological Engineer-Scott Newsom

Scott G. Newsom 4/2/97



**MOUND SITE SOURCE REMOVAL  
POST EXCAVATION AND TRANSPORT  
DECONTAMINATION OF EQUIPMENT**

**Activity Hazard Analysis**

1-28-97

Activity	Hazard	Preventative Measures
All site activities	General work hazards	All personnel will wear steel toed shoes, safety glasses with side shields, hard hats, reflective vests and hearing protection as applicable in the support zone
	Heat stress	Heat stress monitoring will be conducted in regards to work load and PPE worn
	Cold stress	Cold stress monitoring will be conducted Proper clothing will be available to all personnel and administrative controls will be adhered to
	Noise	Noise monitoring will be conducted Where necessary personnel will wear hearing protection In addition, all personnel will participate in the RFETS Hearing Conservation Program if necessary
Traversing the site	Slip, trips, falls	Care will be taken when traversing the site especially when wearing PPE and carrying equipment All trip hazards will be immediately removed or marked when identified
Lifting equipment and materials	Back injury	Proper lifting techniques will be used and heavy equipment, where feasible, will be utilized to move heavy loads

Activity	Hazard	Preventative Measures
Handling equipment and materials	Pinch points and sharp edges	Care will be taken when pinch points and sharp edges exist and heavy duty leather work gloves will be worn
Using hand tools	Hand tools in unsafe operating condition	Hand tools will be inspected by the user prior to each use
	Improper use of hand tools	Hand tools will be utilized for their intended use and operated in accordance with HSP-12 10 Guards will be in place and no modifications will be made
	Electrical shock	Portable power tools will be plugged into a GFCI protected outlet and will be UL listed and double insulated Cords will be inspected and protected from unnecessary damage Any tool whose cord shows signs of damage or deterioration will be immediately removed from service
Use of generators	Electrical shock	Extension cords will be intended for outdoor use inspected by the user, and protected from unnecessary damage Any extension cords which show signs of damage or deterioration will be immediately removed from service
	Electrical shock	Cords will be plugged into a GFCI protected outlet and the generator will be properly grounded The GFCI will be tested by the user daily prior to the beginning of each shift
	Fire	At a minimum, a 10 lb ABC fire extinguisher will be located in the work area and next to the generator All refueling will be conducted at the beginning of the shift when the generators are cool
	Use of gasoline	Follow recommendations on MSDS (see Appendix C)

Activity	Hazard	Preventative Measures
Heavy equipment operation	Heavy equipment in poor operating condition	Heavy equipment will be inspected prior to entering RFETS. The operator will inspect and document all heavy equipment prior to the beginning of each shift.
	Improper operation of heavy equipment	Operators will be properly trained in the use and limitations of all heavy equipment.
	Ground personnel being struck with heavy equipment or falling loads	Ground personnel will wear orange vests, stay at least 20' away from heavy equipment, and maintain line of sight with the operators.
	Other equipment being struck with heavy equipment	Heavy equipment operations will be conducted in a deliberate safe manner. A spotter will be required when backing heavy equipment.
Use of Level B respiratory protection	Physical fatigue	Medical approval will be required for personnel.
	Improper face to facepiece seal	Respirator specific fit test approval will be required for personnel.
	Improper inspection or use of respirator	Personnel will be trained in the inspection procedures, use, and limitations of the specific respirator worn.
	Unsecured airline bottles on heavy equipment	Airline bottles will be inspected by the user prior to and during each shift.
Decontamination and surveying of equipment	Skin exposure to volatile organic compounds	Personnel in the EZ/SCA will wear Level B PPE and limit contact with contaminated soil.
	Inhalation of volatile organic compounds	Personnel in the EZ/SCA will wear Level B respiratory protection. CRZ/RBA and support zone work controls will be based on perimeter real-time VOC monitoring.
	Skin exposure to radionuclides in soil	Personnel in the EZ/SCA will wear Level B PPE and limit contact with contaminated soil.

Activity	Hazard	Preventative Measures
Decontamination and surveying of equipment (cont )	Inhalation of radionuclides	Personnel in the EZ/SCA will wear Level B respiratory protection CRZ and support zone work controls will be based on perimeter air monitoring
	Skin contact with decontamination fluids	Polycoated Tyvek® will be worn if a splash hazard exists
	Work with high temperature, high pressure decontamination systems	High temperature, high pressure decontamination will be conducted only by personnel with current Pressure Safety II training The decontamination system will be inspected prior to use At no time will the wand be pointed at any personnel Polycoated Tyvek®, sixteen inch high steel toed rubber boots, safety glasses with face shield inner and outer nitrile gloves, and hard hat will be worn
Decontamination and surveying of heavy equipment	Ground personnel being struck with heavy equipment	Prior to personnel approaching heavy equipment, the operator will lower all hydraulically controlled implements, set the parking brake, turn the engine off, and give a hand signal indicating that personnel may approach
	Work on elevated surfaces	Work on unprotected elevated surfaces > 6' will be conducted in a full body harness with a lanyard attached to an approved anchorage point In addition all personnel will have current Fall Protection qualification
Pumping decontamination water	Pump malfunction or hose rupture	Pumps and hoses will be inspected by the user prior to use The hoses will be protected from unnecessary damage The discharge end of the hose will be submerged in the holding tank

**Approved**

**Signature**

**Date**

RMRS Project Manager-Wayne Sproles

Wayne Sproles , 4-2-97

RMRS H&S Supervisor-Peggy Schreckengast

Peggy Schreckengast , 4-2-97

RMRS Radiological Coordinator-Jerry Anderson

[Signature] , 4/2/97

SSOC Radiological Engineer-Scott Newsom

Scott G. Newsom , 4/2/97

**MOUND SITE SOURCE REMOVAL  
TRANSPORT AND BACKFILL OF TREATED SOIL**

**Activity Hazard Analysis**

**1-28-97**

Activity	Hazard	Preventative Measures
All site activities	General work hazards	All personnel will wear steel toed shoes, safety glasses with side shields, hard hats, reflective vests and hearing protection as applicable in the support zone
	Heat stress	Heat stress monitoring will be conducted in regards to work load and PPE worn
	Cold stress	Cold stress monitoring will be conducted Proper clothing will be available to all personnel and administrative controls will be adhered to
	Noise	Noise monitoring will be conducted Where necessary personnel will wear hearing protection In addition, all personnel will participate in the RFETS Hearing Conservation Program if necessary
Traversing the site	Slip, trips falls	Care will be taken when traversing the site especially when wearing PPE and carrying equipment All trip hazards will be immediately removed or marked when identified
Lifting equipment and materials	Back injury	Proper lifting techniques will be used and heavy equipment, where feasible, will be utilized to move heavy loads
Handling equipment and materials	Pinch points and sharp edges	Care will be taken when pinch points and sharp edges exist and heavy duty leather work gloves will be worn

Activity	Hazard	Preventative Measures
Using hand tools	Hand tools in unsafe operating condition	Hand tools will be inspected by the user prior to each use
	Improper use of hand tools	Hand tools will be utilized for their intended use and operated in accordance with HSP-12 10 Guards will be in place and no modifications will be made.
	Electrical shock	Portable power tools will be plugged into a GFCI protected outlet and will be UL listed and double insulated Cords will be inspected by the user and protected from unnecessary damage Any tool whose cord shows signs of damage or deterioration will be immediately removed from service
Use of generators	Electrical shock	Extension cords will be intended for outdoor use, inspected by the user, and protected from unnecessary damage Any extension cords which show signs of damage or deterioration will be immediately removed from service
	Electrical shock	Cords will be plugged into a GFCI protected outlet and the generator will be properly grounded The GFCI will be tested by the user daily prior to the beginning of each shift
	Fire	At a minimum, a 10 lb ABC fire extinguisher will be located in the work area and next to the generator All refueling will be conducted at the beginning of the shift when the generators are cool
	Use of gasoline	Follow recommendations on MSDS (see Appendix C)

Activity	Hazard	Preventative Measures
Front end loader and dump truck operations at the excavation and CSFS	Front end loader or dump trucks in poor operating condition	The dump trucks will be inspected prior to entering RFETS The operators will inspect and document the front end loader and dump trucks prior to the beginning of each shift
	Improper operation of the front end loader or dump trucks	Operators will be properly trained in the use and limitations of the front end loaders and dump trucks
	Ground personnel being struck with front end loader dump trucks or falling loads	Ground personnel will wear orange vests stay at least 20' away from the front end loader and dump trucks, and maintain line of sight with the operators
	Vehicular traffic being struck with dump trucks	Prior to movement of the dump trucks, the flagpersons will confirm that they are in position, all traffic is stopped and the path of travel is clear
	Other equipment being struck with front end loader or dump trucks	The dump trucks will be stationary with the parking brake set prior to loading of soil All front end loader and dump truck operations will be conducted in a deliberate safe manner A spotter will be required when backing the front end loader and dump trucks
	Skin exposure to radionuclides in soil	Personnel in the excavation and CSFS EZ/SCA will wear modified level D PPE and limit contact with contaminated soil
	Inhalation of radionuclides	High volume air sampling will be conducted in the work area
	Spills or dust generation during transport	A one foot freeboard will be maintained at all times Water will be sprayed on the load prior to transport and speed will be limited to 5 mph Direct observation will ensure prompt response should a spill or dust generation occur



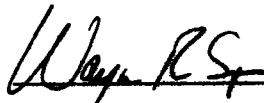
Activity	Hazard	Preventative Measures
Dumping treated soil at the excavation	Ground personnel being engulfed by dumped soil	Ground personnel will stay at least 30' from the dump truck and the operator will not dump the load until given a visual hand signal from the spotter
	Dump truck falling into trench	A spotter will use hand signals to ensure that dump trucks stay a minimum of six feet away from the edge of the trench when dumping
Working around open trench	Slips, trips, falls into trench	Personnel will stay a minimum of six feet away from the edge of the trench. Personnel closer than six feet must wear a full body harness and lifeline attached to an approved anchorage point
	Sloughing of trench walls	The trench will be inspected prior to and during each shift
	Equipment falling into trench	All equipment will be kept a minimum of six feet away from the edge of the trench
Spraying water for dust control	Pump malfunction or hose rupture	Pumps and hoses will be inspected by the user prior to use. The hoses will be protected from unnecessary damage

Approved


Signature

Date

RMRS Project Manager-Wayne Sproles

 4-2-97

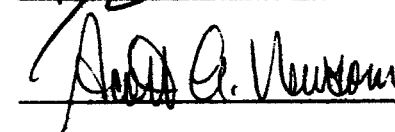
RMRS H&amp;S Supervisor-Peggy Schreckengast

 4/2/97

RMRS Radiological Coordinator-Jerry Anderson

 4/2/97

SSOC Radiological Engineer-Scott Newsom

 4/2/97

**MOUND SITE SOURCE REMOVAL  
POST TRANSPORT AND BACKFILL  
DECONTAMINATION OF EQUIPMENT**

**Activity Hazard Analysis**

**1-28-97**

Activity	Hazard	Preventative Measures
All site activities	General work hazards	All personnel will wear steel toed shoes, safety glasses with side shields, hard hats, reflective vests, and hearing protection as applicable in the support zone
	Heat stress	Heat stress monitoring will be conducted in regards to work load and PPE worn
	Cold stress	Cold stress monitoring will be conducted Proper clothing will be available to all personnel and administrative controls will be adhered to
	Noise	Noise monitoring will be conducted Where necessary personnel will wear hearing protection In addition, all personnel will participate in the RFETS Hearing Conservation Program if necessary
Traversing the site	Slip trips falls	Care will be taken when traversing the site especially when wearing PPE and carrying equipment All trip hazards will be immediately removed or marked when identified
Lifting equipment and materials	Back injury	Proper lifting techniques will be used and heavy equipment, where feasible, will be utilized to move heavy loads
Handling equipment and materials	Pinch points and sharp edges	Care will be taken when pinch points and sharp edges exist and heavy duty leather work gloves will be worn

Activity	Hazard	Preventative Measures
Using hand tools	Hand tools in unsafe operating condition	Hand tools will be inspected by the user prior to each use
	Improper use of hand tools	Hand tools will be utilized for their intended use and operated in accordance with HSP-12 10 Guards will be in place and no modifications will be made
	Electrical shock	Portable power tools will be plugged into a GFCI protected outlet and will be UL listed and double insulated Cords will be inspected by the user and protected from unnecessary damage Any tool whose cord shows signs of damage or deterioration will be immediately removed from service
Use of generators	Electrical shock	Extension cords will be intended for outdoor use, inspected by the user, and protected from unnecessary damage Any extension cords which show signs of damage or deterioration will be immediately removed from service
	Electrical shock	Cords will be plugged into a GFCI protected outlet and the generator will be properly grounded The GFCI will be tested by the user daily prior to the beginning of each shift
	Fire	At a minimum, a 10 lb ABC fire extinguisher will be located in the work area and next to the generator All refueling will be conducted at the beginning of the shift when the generators are cool
	Use of gasoline	Follow recommendations on MSDS (see Appendix C)

Activity	Hazard	Preventative Measures
Heavy equipment operation	Heavy equipment in poor operating condition	Heavy equipment will be inspected prior to entering RFETS. Operators will inspect and document all heavy equipment prior to the beginning of each shift.
	Improper operation of heavy equipment	Operators will be properly trained in the use and limitations of all heavy equipment.
	Ground personnel being struck with heavy equipment or falling loads	Ground personnel will wear orange vests, stay at least 20' away from heavy equipment, and maintain line of sight with the operators.
	Other equipment being struck with heavy equipment	Heavy equipment operations will be conducted in a deliberate safe manner. A spotter will be required when backing heavy equipment.
Decontamination of equipment	Skin contact with decontamination fluids	Polycoated Tyvek® will be worn if a splash hazard exists.
	Work with high temperature high pressure decontamination systems	High temperature, high pressure decontamination will be conducted only by personnel with current Pressure Safety II training. The decontamination system will be inspected prior to use. At no time will the wand be pointed at any personnel. Polycoated Tyvek®, sixteen inch high steel toed rubber boots, safety glasses with face shield, inner and outer nitrile gloves and hard hat will be worn.
Decontamination and surveying of heavy equipment	Ground personnel being struck with heavy equipment	Prior to personnel approaching heavy equipment, the operator will lower all hydraulically controlled implements, set the parking brake, turn the engine off, and give a hand signal indicating that personnel may approach.


Activity	Hazard	Preventative Measures
Decontamination and surveying of heavy equipment	Work on elevated surfaces	All work on unprotected elevated surfaces > 6' will be conducted in a full body harness with a lanyard attached to an approved anchorage point. In addition all personnel will have current Fall Protection qualification.
	Skin exposure to radionuclides in soil	Personnel in the EZ/SCA will wear modified level D PPE and limit contact with contaminated soil.
	Inhalation of radionuclides	High volume air sampling will be conducted in the work area.
	Pump malfunction or hose rupture	Pumps and hoses will be inspected by the user prior to use. The hoses will be protected from unnecessary damage. The discharge end of the hose will be submerged in the holding tank.

Approved

Signature

Date

RMRS Project Manager-Wayne Sproles

 4-2-97

RMRS H&amp;S Supervisor-Peggy Schreckengast

 4/2/97

RMRS Radiological Coordinator-Jerry Anderson

 4/2/97

SSOC Radiological Engineer-Scott Newsom

 4/2/97

# **MOUND SITE SOURCE REMOVAL**

## **SITE RECLAMATION**

### **Activity Hazard Analysis**

**1-28-97**

<b>Activity</b>	<b>Hazard</b>	<b>Preventative Measures</b>
<b>All site activities</b>	<b>General work hazards</b>	All personnel will wear steel toed shoes, safety glasses with side shields, hard hats, reflective vests, and hearing protection as applicable in the support zone
	<b>Heat stress</b>	Heat stress monitoring will be conducted in regards to work load and PPE worn
	<b>Cold stress</b>	Cold stress monitoring will be conducted Proper clothing will be available to all personnel and administrative controls will be adhered to
	<b>Noise</b>	Noise monitoring will be conducted Where necessary personnel will wear hearing protection In addition, all personnel will participate in the RFETS Hearing Conservation Program if necessary
<b>Traversing the site</b>	<b>Slip, trips, falls</b>	Care will be taken when traversing the site especially when carrying equipment All trip hazards will be immediately removed or marked when identified
<b>Lifting equipment and materials</b>	<b>Back injury</b>	Proper lifting techniques will be used and heavy equipment, where feasible, will be utilized to move heavy loads
<b>Handling equipment and materials</b>	<b>Pinch points and sharp edges</b>	Care will be taken when pinch points and sharp edges exist and heavy duty leather work gloves will be worn

Activity	Hazard	Preventative Measures
Using hand tools to dismantle secondary containments	Hand tools in unsafe operating condition	Hand tools will be inspected by the user prior to each use
	Improper use of hand tools	Hand tools will be utilized for their intended use and operated in accordance with HSP-12 10 Guards will be in place and no modifications will be made
	Electrical shock	Portable power tools will be plugged into a GFCI protected outlet and will be UL listed and double insulated Cords will be inspected by the user and protected from unnecessary damage Any tool whose cord shows signs of damage or deterioration will be immediately removed from service
Use of generators	Electrical shock	Extension cords will be intended for outdoor use, inspected by the user, and protected from unnecessary damage Any extension cords which show signs of damage or deterioration will be immediately removed from service
	Electrical shock	Cords will be plugged into a GFCI protected outlet and the generator will be properly grounded The GFCI will be tested by the user daily prior to the beginning of each shift
	Fire	At a minimum, a 10 lb ABC fire extinguisher will be located in the work area and next to the generator All refueling will be conducted at the beginning of the shift when the generators are cool
	Use of gasoline	Follow recommendations on MSDS (see Appendix C)

Activity	Hazard	Preventative Measures
Using fork truck to move poly tanks, pumps, generators and jersey barriers	Fork truck in poor operating condition	The operator will inspect and document the fork truck prior to the beginning of each shift
	Improper operation of fork truck	Operators will hold a current Fork Truck Operator Permit and all operations will be in accordance with HSP-9 06
	Ground personnel being struck with fork truck	Ground personnel will wear orange vests and maintain line of sight with the fork truck operator
	Other equipment being struck with fork truck	Fork truck operations will be conducted in a deliberate safe manner A spotter will be required when backing the fork truck
	Injury resulting from unsecured loads	Loads will be secured Jersey barriers will be moved with the forks in the lowest possible position and personnel will stay back a minimum of ten feet
Removing fence posts, ground rods, or equipment hold downs	Pinch points	Pay particular attention to pinch points when using pneumatic/hydraulic or slide type devices
	Ear injury	Hearing protection will be worn
Heavy equipment operation to replace topsoil and grade excavation and CSFS areas	Heavy equipment in poor operating condition	Heavy equipment will be inspected prior to entering RFETS The operators will inspect and document all heavy equipment prior to the beginning of each shift
	Improper operation of heavy equipment	Operators will be properly trained in the use and limitations of all heavy equipment
	Ground personnel being struck with heavy equipment or falling loads	Personnel will wear orange vests, stay at least 20 away from heavy equipment, and maintain line of sight with the operators



Activity	Hazard	Preventative Measures
Heavy equipment operation to replace topsoil and grade excavation and CSFS areas (cont )	Other equipment being struck with heavy equipment	Heavy equipment operations will be conducted in a deliberate safe manner A spotter will be required when backing heavy equipment
	Skin exposure to radionuclides in soil	Personnel in the excavation or CSFS EZ/SCA will wear modified level D PPE and limit contact with contaminated soil
	Inhalation of radionuclides	High volume air sampling will be conducted in the work area

Approved

Signature

Date

RMRS Project Manager-Wayne Sproles

Wayne R Sproles 4-2-97

RMRS H&amp;S Supervisor-Peggy Schreckengast

Peggy Schreckengast 4-2-97

RMRS Radiological Coordinator-Jerry Anderson

Jerry Anderson 4/2/97

SSOC Radiological Engineer-Scott Newsom

Scott A. Newsom 4/2/97

**MOUND SITE SOURCE REMOVAL  
REPAIR DOMESTIC WATER LINE**

**Activity Hazard Analysis**

**3-23-97**

Activity	Hazard	Preventative Measures
All site activities	General work hazards	All personnel will wear steel toed shoes, safety glasses with side shields, hard hats, reflective vests, and hearing protection as applicable in the support zone
	Heat stress	Heat stress monitoring will be conducted in regards to work load and PPE worn
	Cold stress	Cold stress monitoring will be conducted Proper clothing will be available to all personnel and administrative controls will be adhered to
	Noise	Noise monitoring will be conducted Where necessary personnel will wear hearing protection In addition, all personnel will participate in the RFETS Hearing Conservation Program if necessary
Traversing the site	Slip, trips falls	Care will be taken when traversing the site especially when wearing PPE and carrying equipment All trip hazards will be immediately removed or marked when identified
Lifting equipment and materials	Back injury	Proper lifting techniques will be used and heavy equipment, where feasible, will be utilized to move heavy loads
Handling equipment and materials	Pinch points and sharp edges	Care will be taken when pinch points and sharp edges exist and heavy duty leather work gloves will be worn

Activity	Hazard	Preventative Measures
Using hand tools	Hand tools in unsafe operating condition	Hand tools will be inspected by the user prior to each use
	Improper use of hand tools	Hand tools will be utilized for their intended use and operated in accordance with HSP-12.10 Guards will be in place and no modifications will be made
	Electrical shock	Portable power tools will be plugged into a GFCI protected outlet and will be UL listed and double insulated Cords will be inspected by the user and protected from unnecessary damage Any tool whose cord shows signs of damage or deterioration will be immediately removed from service
Use of generators	Electrical shock	Extension cords will be intended for outdoor use, inspected by the user, and protected from unnecessary damage. Any extension cords which show signs of damage or deterioration will be immediately removed from service.
	Electrical shock	Cords will be plugged into a GFCI protected outlet and the generator will be properly grounded The GFCI will be tested by the user daily prior to the beginning of each shift
	Fire	At a minimum, a 10 lb ABC fire extinguisher will be located in the work area and next to the generator All refueling will be conducted at the beginning of the shift when the generators are cool
	Use of gasoline	Follow recommendations on MSDS (see Appendix C)

Activity	Hazard	Preventative Measures
Trackhoe operation	Trackhoe in poor operating condition	The trackhoe will be inspected prior to entering RFETS. The operator will inspect and document the trackhoe prior to the beginning of each shift.
	Improper operation of the trackhoe	Operators will be properly trained in the use and limitations of the trackhoe.
	Ground personnel being struck with trackhoe or falling loads	Ground personnel will wear orange vests, stay at least 20' away from the trackhoe, and maintain line of sight with the operator.
	Other equipment being struck with trackhoe	The forty ton dump truck will be stationary with the parking brake set prior to loading of soil. Trackhoe operations will be conducted in a deliberate safe manner. A spotter will be required when backing the trackhoe.
Use of Level B respiratory protection	Physical fatigue	Medical approval will be required for personnel.
	Improper face to facepiece seal	Respirator specific fit test approval will be required for personnel.
	Improper inspection or use of respirator	Personnel will be trained in the inspection, use, and limitations of the specific respirator worn.
	Unsecured airline bottles on trackhoe	Airline bottles will be inspected by the user prior to and during each shift.
Excavating contaminated soil	Skin exposure to volatile organic compounds	Personnel in the EZ/SCA will wear Level B PPE and limit contact with contaminated soil.
	Inhalation of volatile organic compounds	Personnel in the EZ/SCA will wear Level B respiratory protection. CRZ/RBA and support zone work controls will be based on perimeter real-time VOC monitoring.

Activity	Hazard	Preventative Measures
Excavating contaminated soil (cont )	Skin exposure to radionuclides in soil	Personnel in the EZ/SCA will wear Level B PPE and limit contact with contaminated soil
	Inhalation of radionuclides	Personnel in the EZ/SCA will wear Level B respiratory protection CRZ/RBA and support zone work controls will be based on perimeter air monitoring
Excavating to expose water line to the north	Trackhoe falling into trench	Spotter will monitor stability of trench wall
Working around open trench	Slips, trips, falls into trench	Personnel will stay a minimum of six feet away from the edge of the trench Personnel closer than six feet must wear a full body harness and lifeline attached to an approved anchorage point
	Sloughing of trench walls	The trench will be inspected prior to and during each shift.
	Equipment falling into trench	All equipment, except the excavator, will be kept a minimum of six feet away from the edge of the trench
Obtaining FIDLER readings at the trackhoe bucket	Ground personnel being struck with trackhoe	Prior to the RCT approaching the bucket, the operator will set the bucket on the ground, disengage the hydraulic system, set the parking brake, and give a hand signal indicating that the RCT may approach
Spraying water for dust control and pumping decontamination or incidental water into the holding tanks or into tanker trucks	Pump malfunction or hose rupture	Pumps and hoses will be inspected by the user prior to use The hoses will be protected from unnecessary damage The discharge end of the incidental water hose will be submerged in the holding tank Tankers will be filled in accordance with their safety guidelines

Activity	Hazard	Preventative Measures
Entering the trench	Cave in of newly excavated trench walls	The trench will be sloped at a 1 5 1 angle to facilitate entry and egress A competent person will inspect the trench and evaluate the need for further sloping or shoring
	Cave in of existing trench walls	The pipefitter will wear a full body harness, a motion restraint tagline, and be connected to an approved anchorage point In addition, the pipefitter will have current fall protection training
Hooking up a hose to the water line	Failure of hose fitting device or hose	The water will not be turned on until the pipefitter has exited the trench
Sanitizing the cap	Use of Clorox®	Follow attached MSDS
Soldering the cap	Explosion	Monitoring will be performed for combustible gases The torch will be operated in accordance with HSP-12 11
	Fire	A Burn Permit will be obtained from RFFD A 10 lb fire extinguisher will be located in the work area and a fire watch will be posted

Approved

Signature

Date

RMRS Project Manager-Wayne Sproles

Wayne Sproles, 3/24/97

RMRS H&S Supervisor-Peggy Schreckengast

Peggy Schreckengast, 3/24/97

RMRS Radiological Coordinator-Jerry Anderson

Jerry Anderson, 3/24/97

SSOC Radiological Engineer-Scott Newsom

Scott Newsom, 3/24/97



The Clorox Company  
7200 Johnson Drive  
Pleasanton, California 94508  
Tel (415) 847-8100

REC'D OCT 12 1987

## Material Safety Data Sheet

CLOROX-NHHS	
HEALTH	2*
FLAMMABILITY	0
REACTIVITY	1
Personal Protection	8

### I Chemical Identification

**NAME:** REGULAR CLOROX BLEACH

**CAS no.** N/A

**DESCRIPTION:** CLEAR, LIGHT YELLOW LIQUID WITH CHLORINE ODOR

**RTECS no.** N/A

#### Other Designations

#### Manufacturer

#### Emergency Procedure

EPA Reg No 5813-1  
Sodium hypochlorite solution  
Liquid chlorine bleach  
Clorox Liquid Bleach

The Clorox Company  
1221 Broadway  
Oakland, CA. 94612

Notify your Supervisor  
Call your local poison control center  
or

Rocky Mountain Poison Center  
(303) 573-1014

### II Health Hazard Data

\*Causes severe but temporary eye injury. May irritate skin. May cause nausea and vomiting if ingested. Exposure to vapor or mist may irritate nose, throat and lungs. The following medical conditions may be aggravated by exposure to high concentrations of vapor or mist: heart conditions or chronic respiratory problems such as asthma, chronic bronchitis or obstructive lung diseases. Under normal consumer use conditions the likelihood of any adverse health effects are low. **FIRST AID:** **EYE CONTACT:** Immediately flush eyes with plenty of water. If irritation persists, see a doctor. **SKIN CONTACT:** Remove contaminated clothing. Wash area with water. **INGESTION:** Drink a glassful of water and call a physician. **INHALATION:** If breathing problems develop remove to fresh air.

### III Hazardous Ingredients

Ingredients	Concentration	Worker Exposure Limit
Sodium hypochlorite CAS# 7681-52-9	5.25%	not established

None of the ingredients in this product are on the IARC, NTP or OSHA carcinogen list. Occasional clinical reports suggest a low potential for sensitization upon exaggerated exposure to sodium hypochlorite if skin damage (eg irritation) occurs during exposure. Routine clinical tests conducted on intact skin with Clorox Liquid Bleach found no sensitization in the test subjects.

### IV Special Protection Information

**Hygienic Practices:** Wear safety glasses. With repeated or prolonged use wear gloves.

**Engineering Controls:** Use general ventilation to minimize exposure to vapor or mist.

**Work Practices:** Avoid eye and skin contact and inhalation of vapor or mist.

### V Special Precautions

Keep out of reach of children. Do not get in eyes or on skin. Wash thoroughly with soap and water after handling. Do not mix with other household chemicals such as toilet bowl cleaners, rust removers, vinegar, acid or ammonia containing products. Store in a cool, dry place. Do not reuse empty container. Rinse container and put in trash container.

### VI Spill or Leak Procedures

Small quantities of less than 5 gallons may be flushed down drain. For larger quantities wipe up with an absorbent material or mop and dispose of in accordance with local, state and federal regulations. Dilute with water to minimize oxidizing effect on spilled surface.

### VII Reactivity Data

Stable under normal use and storage conditions. Strong oxidizing agent. Reacts with other household chemicals such as toilet bowl cleaners, rust removers, vinegar, acids or ammonia containing products to produce hazardous gases such as chlorine and other chlorinated species. Prolonged contact with metal may cause pitting or discoloration.

### VIII Fire and Explosion Data

Not flammable or explosive. In a fire, cool containers to prevent rupture and release of sodium chlorate.

### IX Physical Data

Boiling point-----212°F/100°C (decomposes)  
Specific Gravity (H<sub>2</sub>O=1)-----1.065  
Solubility in Water-----complete  
pH-----11.4



The Clorox Company  
7200 Johnson Drive  
Pleasanton, California 94566  
Tel. (510) 847-6100

# Material Safety Data Sheet

AUG 04 1992

CLOROX-9900	
HEALTH	2
FLAMMABILITY	0
REACTIVITY	1
PERSONAL	0

<b>I Product:</b> <u>REGULAR CLOROX BLEACH</u>																	
<b>Description.</b> CLEAR, LIGHT YELLOW LIQUID WITH CHLORINE ODOR																	
<b>Other Designations</b>	<b>Manufacturer</b>	<b>Emergency Telephone No.</b>															
EPA Reg. No. 6818-1 Sodium hypochlorite solution Liquid chlorine bleach Clorox Liquid Bleach	The Clorox Company 1221 Broadway Oakland, CA 94612	Notify your Supervisor Rocky Mountain Poison Center (800) 446-1014 For Transportation Emergencies Call: (800) 424-9300															
<b>II Health Hazard Data</b>		<b>III Hazardous Ingredients</b>															
<p>* Causes severe but temporary eye injury. May irritate skin. May cause nausea and vomiting if ingested. Exposure to vapor or mist may irritate nose, throat and lungs. The following medical conditions may be aggravated by exposure to high concentrations of vapor or mist: heart conditions or chronic respiratory problems such as asthma, chronic bronchitis or obstructive lung disease. Under normal consumer use conditions the likelihood of any adverse health effects are low.</p> <p><b>FIRST AID:</b> <u>EYE CONTACT:</u> Immediately flush eyes with plenty of water. If irritation persists, see a doctor. <u>SKIN CONTACT:</u> Remove contaminated clothing. Wash area with water. <u>INGESTION:</u> Drink a glassful of water and call a physician. <u>INHALATION:</u> If breathing problems develop remove to fresh air.</p>		<table border="1"> <thead> <tr> <th>Ingredient</th> <th>Concentration</th> <th>Worker Exposure Limit</th> </tr> </thead> <tbody> <tr> <td>Sodium Hypochlorite</td> <td>5.25%</td> <td>not established</td> </tr> <tr> <td>Sodium hypochlorite</td> <td></td> <td></td> </tr> <tr> <td>CAS # 7681-90-0</td> <td></td> <td></td> </tr> <tr> <td>7681-52-9</td> <td></td> <td></td> </tr> </tbody> </table> <p>Name of the ingredients in this product are on the IARC, NTP or OSHA carcinogen list. Occasional clinical reports suggest a low potential for sensitization upon exaggerated exposure to sodium hypochlorite if skin damage (e.g. irritation) occurs during exposure. Routine clinical tests conducted on intact skin with Clorox Liquid Bleach found no sensitization in the test subjects.</p>	Ingredient	Concentration	Worker Exposure Limit	Sodium Hypochlorite	5.25%	not established	Sodium hypochlorite			CAS # 7681-90-0			7681-52-9		
Ingredient	Concentration	Worker Exposure Limit															
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CAS # 7681-90-0																	
7681-52-9																	
<b>IV Special Protection and Precautions</b>		<b>V Transportation and Regulatory Data</b>															
<p><u>Hygiene Practices:</u> Wear safety glasses. With repeated or prolonged use, wear gloves.</p> <p><u>Engineering Controls:</u> Use general ventilation to minimize exposure to vapor or mist.</p> <p><u>Work Practices:</u> Avoid eye and skin contact and inhalation of vapor or mist.</p> <p><u>Keep out of the reach of children.</u></p>		<p><u>U.S. DOT Hazard Class:</u> Not restricted</p> <p><u>U.S. DOT Proper Shipping Name:</u> Hypochlorite solution with less than 7% available chlorine. Not Restricted per 49CFR172.101(a)(2)(iv)</p> <p><u>Section 319 (Title III Superfund Amendments and Reauthorization Act):</u> As a consumer product, this product is exempt from supplier notification requirements under Section 319 Title III of the Superfund Amc. Control and Reauthorization Act of 1980 (reference 40 CFR Part 372)</p>															
<b>VI Spill or Leak Procedures</b>		<b>VII Reactivity Data</b>															
<p><u>Small Spills</u> (&lt;5 gallons)</p> <p>(1) Absorb, containerize, and landfill in accordance with local regulations.</p> <p>(2) Wash down residual to sanitary sewer *</p> <p><u>Large Spills</u> (&gt;5 gallons)</p> <p>(1) Absorb, containerize, and landfill in accordance with local regulations; wash down residual to sanitary sewer * - OR - (2) Pump material to waste drum(s) and dispose in accordance with local regulations; wash down residual to sanitary sewer *</p> <p>* Contact the sanitary treatment facility in advance to assure ability to process washed-down material.</p>		<p>Stable under normal use and storage conditions. Strong oxidizing agent. Reacts with other household chemicals such as toilet bowl cleaners, rust removers, vinegar, acids or ammonia containing products to produce hazardous gases, such as chlorine and other chlorinated species. Prolonged contact with metal may cause pitting or discoloration.</p>															
<b>VIII Fire and Explosion Data</b>		<b>IX Physical Data</b>															
Not flammable or explosive. In a fire, cool containers to prevent rupture and release of sodium chlorate.		<p>Boiling point 212°F/100°C</p> <p>Specific Gravity (H<sub>2</sub>O=1) 1.08</p> <p>Solubility in Water completely soluble</p> <p>pH 11.4</p>															



# Acetylene Material Safety Data Sheet

Industrial Gas Division  
Air Products and Chemicals Inc.  
P O Box 538  
Allentown PA 18105  
Tel. (215) 481-4911 • TWX 510-851-3686  
CABLE-AIRPROD • TELEX 84-7416

**AIR  
PRODUCTS**

AUG 16 1993

REC'D SEP 15 1986

EMERGENCY PHONE 800-523-8374 IN PENNSYLVANIA 800-322-9082	TRADE NAME AND SYNONYMS <b>Acetylene, Ethyne, Ethine</b>	CHEMICAL NAME AND SYNONYMS <b>Acetylene, Ethyne, Ethine</b>
ISSUE DATE AND REVISIONS Issued 31 January 1978 Rev 23 October 1985	FORMULA <b>C<sub>2</sub>H<sub>2</sub> MW 26.04</b>	CHEMICAL FAMILY <b>Alkynes CAS#74-86-2</b>

## HEALTH HAZARD DATA

### THRESHOLD LIMIT VALUE

Acetylene is classified as a simple asphyxiant and has no threshold limit value (TLV)

### SYMPTOMS IF INGESTED CONTACTED WITH SKIN OR VAPOR INHALED

Symptoms such as headaches, dizziness, shortness of breath and loss of consciousness may occur if the gas is present in quantities sufficient to dilute the oxygen concentration in air. Symptoms of anoxia occur only when the gas concentrations are within the flammable range and the mixture has not ignited. (DO NOT ENTER AREAS WITHIN THE FLAMMABLE RANGE DUE TO THE IMMEDIATE FIRE AND EXPLOSION HAZARD) Use a suitable flammable gas meter (explosimeter) calibrated for acetylene to measure concentrations of gas in the air.

### TOXICOLOGICAL PROPERTIES

Acetylene is a simple asphyxiant, irritant and anesthetic. About 100 mg per liter may be tolerated for 0.5-1.0 hour. There is no experimental evidence of chronic harmful effects.

### RECOMMENDED FIRST AID TREATMENT

First degree and minor second degree thermal burns from fires should be immersed in cool water for 30 minutes. Major second and third degree burns should be covered in the cleanest material available. Seek immediate aid of a physician. Persons suffering from lack of oxygen should be moved to areas with normal atmosphere. Assisted respiration and supplemental oxygen should be given if the victim is not breathing.

## FIRE AND EXPLOSION HAZARD DATA

### FLASH POINT (method used)

0°F (-18°C) (CC)

### AUTO IGNITION TEMP

581°F (305°C)

### FLAMMABLE LIMITS

In air @ 1 atm

### LEL

2.5%

### UEL

100%

### EXTINGUISHING MEDIA

Carbon dioxide, dry chemical, Halon

### ELECTRICAL CLASSIFICATION

GROUP Class 1 Group A

### SPECIAL FIRE FIGHTING PROCEDURES

Stop gas flow and fight fire conventionally. Use water spray to keep cylinders or other containers cool if exposed to fire. Keep personnel well away since containers can rupture violently when exposed to fire. For additional information see Compressed Gas Association Safety Bulletin SB-4.

### UNUSUAL FIRE AND EXPLOSION HAZARDS

ACETYLENE IS EXTREMELY FLAMMABLE AND EXPLOSIVE. IT MAY DECOMPOSE VIOLENTLY IN ITS FREE STATE UNDER PRESSURE IN EXCESS OF 15 PSIG. It burns with an intensely hot flame. Potential explosion hazard exists from re-ignition if fire is extinguished without shutting off acetylene source. Ignites very easily due to low minimum ignition energy, very wide flammable limits. Acetylene gas has an approximate specific gravity of 1.0 and tends to stay in pockets rather than dissipate.

## PHYSICAL DATA

### BOILING POINT (°F.)

@ 1 atm -119.2°F (-84.0°C)

### FREEZING POINT (°F.)

@ 1 atm -113.4°F (-80.8°C)

### VAPOR PRESSURE (psia)

@ 62.2°F (16.8°C) 590 psia (40 atm)

### SOLUBILITY IN WATER

@ 64°F (18°C), 1 atm 1.0 CuFt/CuFtH<sub>2</sub>O

### VAPOR DENSITY (R/LU R)

@ 68°F (20°C) 1 atm 0.968

### SPECIFIC GRAVITY (AIR = 1)

@ 68°F (20°C) 1 atm 0.906

### LIQUID DENSITY (R/LU R)

@ -116°F (-82°C), 1 atm 38.76

### SPECIFIC GRAVITY (H<sub>2</sub>O = 1)

@ -116°F (-82°C) 1 atm 0.621

### APPEARANCE AND ODOR

Pure acetylene is colorless and odorless. Impurities in carbide generated acetylene impart a characteristic garlic like odor.

## DISCLAIMER

Information contained in this data sheet is offered without charge for use by technically qualified personnel at their discretion and risk. All statements, technical information and recommendations contained herein are based on tests and data which we believe to be reliable, but the accuracy or completeness thereof is not guaranteed and no warranty of any kind is made with respect thereto. This information is not intended as a license to operate under or a recommendation to practice or infringe any patent of this Company or others covering any process, composition of matter or use. Since the Company shall have no control of the use of the product described herein, the Company assumes no liability for loss or damage incurred from the proper or improper use of such product.

## REACTIVITY DATA

UNSTABLE	X
STABLE	

**CONDITIONS TO AVOID**  
 Never utilize free gas outside the cylinder at pressures in excess of 15 psig. Avoid mechanical shocks to containers of acetylene. Never expose cylinders or acetylene systems to sources of heat.

### INCOMPATIBILITY (Materials to avoid)

Oxidizers such as oxygen and halogens. Forms explosive compounds with copper, brass, copper salts, Hg and Hg salts, K, Ag and g salts, and HNO<sub>3</sub>.

### HAZARDOUS DECOMPOSITION PRODUCTS

Acetylene will decompose into elemental carbon and hydrogen under the above conditions.

HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID
	WILL NOT OCCUR	X	

## SPILL OR LEAK PROCEDURES

### STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Ventilate area to prevent flammable mixture from forming. Remove sources of ignition, heat, sparks, etc. Avoid entering area of flammable atmosphere. Carefully remove cylinders with slow leaks to a remote outdoor location. Contact Air Products for assistance.

### WASTE DISPOSAL METHOD

Do not attempt to dispose of residual gaseous acetylene in cylinders. Return to Air Products for disposal.

## SPECIAL PROTECTION INFORMATION

### RESPIRATORY PROTECTION (Specify type)

Oxygen deficient atmospheres are in the flammable range. DO NOT ENTER. Respirators will not function.

VENTILATION Natural or mechanical where gas is present	LOCAL EXHAUST	SPECIAL Mechanical ventilation for enclosed storage areas must meet National Electrical Code requirements for Class 1 Group A.
	MECHANICAL (General)	OTHER

### PROTECTIVE GLOVES

Ordinary leather work gloves recommended for cylinder handling. Welders gloves required for cutting and welding operations.

### EYE PROTECTION

Safety glasses recommended for handling cylinders. Welders goggles, etc. required for cutting and welding.

### OTHER PROTECTIVE EQUIPMENT

Welding sleeves, leather apron and other standard protective equipment for cutting and welding.

## SPECIAL PRECAUTIONS\*

### SPECIAL LABELING INFORMATION

Acetylene shipments must be in accordance with Department of Transportation (DOT) regulations using the DOT FLAMMABLE GAS label. Consult DOT regulations for details on the shipping of hazardous materials.

### SPECIAL HANDLING RECOMMENDATIONS

Use only in well ventilated areas. Acetylene gas cylinders contain gas at high pressure and should be handled with care. Use a pressure reducing regulator set at less than 15 psig. Always keep acetylene cylinders upright and secure cylinders when in use. Never expose an acetylene cylinder to heat. Always open and close acetylene valves slowly. Return cylinders to Air Products with positive pressure and cylinder valve closed. Avoid dragging, rolling, or sliding cylinders even for a short distance. Use a suitable hand truck. For additional handling recommendations on compressed gas cylinders, consult Compressed Gas Association Pamphlet P-1.

### SPECIAL STORAGE RECOMMENDATIONS

Storage of 2500 cubic feet or less is permissible within buildings. Storage in excess of 2500 cubic feet must be outdoors or in well ventilated special rooms or buildings. Keep cylinders away from sources of heat. Storage should not be in heavy traffic area to prevent accidental knocking over or damage from passing or falling objects. Valve caps should remain on cylinders not connected for use. Segregate full and empty cylinders. Keep acetylene cylinders storage areas away from storage of oxygen and other oxidizers. Storage areas should be free of combustible material. Avoid exposure to areas where salt or other corrosive chemicals are present. Store acetylene cylinders with the valve end up. See Compressed Gas Association Pamphlet P-1 and National Fire Protection Association Standard No. 51 for additional storage recommendations.

### SPECIAL PACKAGING RECOMMENDATIONS

Acetylene is packaged in cylinders meeting DOT specification 8 or 8AL. The cylinder contains a porous filler saturated with acetone. The acetylene stored in the cylinder is dissolved in acetone. A full cylinder should not exceed 250 psig @ 70°F.

### OTHER RECOMMENDATIONS OR PRECAUTIONS

Acetylene cylinders should be stored and used in an upright position. When using acetylene, close the cylinder valve before shutting off the regulator to permit the gas to bleed from the regulator. Avoid hazardous mixtures and sources of ignition. Formation of explosive copper acetylides can be avoided by using copper alloys proved successful through use in industry. Compressed gas cylinders should not be refilled except by qualified producers of compressed gases. Shipment of a compressed gas cylinder filled without the permission of the owner is a violation of Federal Law.

Other Government agencies (i.e. Department of Transportation, Occupational Safety and Health Administration, Food and Drug Administration and others) may have specific regulations concerning the transportation, handling, storage or use of this product which are reflected in this data sheet. The customer should review these regulations to ensure that he is in full compliance.

## APPENDIX C

### MATERIAL SAFETY DATA SHEETS

ConCover® "A" Bag

ConCover® B Bag

Diesel

Hydraulic Oil

Hydrochloric Acid

Liquinox®

Nitric Acid

Pipex®

Sodium Hydroxide

Sulfuric Acid

Unleaded Gasoline

002 07/01/93 HYDROCHLORIC ACID, TECHNICAL, 22 DEG BAUME'

PRODUCT NAME  
HYDROCHLORIC ACID, TECHNICAL, 22 DEG BAUME'

MSDS # DE40513

1 INGREDIENTS (% w/w, unless otherwise noted)

Hydrogen chloride  
Water

CAS# 007647-01-0  
CAS# 007732-18-5

35.2%  
Balance

2 PHYSICAL DATA

BOILING POINT. 142F (61.1C)  
VAP PRESS 76 mmHg @ 20C  
VAP DENSITY (Air=1) 10.0  
SOL IN WATER. Infinite.  
SP. GRAVITY. 1.18  
APPEARANCE White to yellow clear liquid.  
ODOUR: Pungent odor.



3 FIRE AND EXPLOSION HAZARD DATA.

FLASH POINT: None  
METHOD USED. TCC

FLAMMABLE LIMITS  
LFL: Not applicable  
UFL: Not applicable

EXTINGUISHING MEDIA: Non-flammable.

FIRE & EXPLOSION HAZARDS: Hydrochloric acid itself is non-flammable. There is, however, a latent fire or explosion hazard due to hydrogen gas generated when acid is in contact with metals

FIRE-FIGHTING EQUIPMENT: Wear positive pressure self-contained breathing apparatus.

4 REACTIVITY DATA.

STABILITY: (CONDITIONS TO AVOID) Contact with metals may cause generation of flammable concentrations of hydrogen gas.

INCOMPATIBILITY: (SPECIFIC MATERIALS TO AVOID) Avoid base and corrosive materials. Avoid contact with most metals. Avoid oxidizing material, can oxidize to chlorine.

HAZARDOUS DECOMPOSITION PRODUCTS: None.

HAZARDOUS POLYMERIZATION: Will not occur.

5 ENVIRONMENTAL AND DISPOSAL INFORMATION:

ACTION TO TAKE FOR SPILLS/LEAKS: Small quantities may be flushed with copious quantities of water; in case of larger amounts, contain liquid. Use limestone, lime or soda ash to cautiously neutralize since considerable amounts of heat and steam may be generated on neutralization.

DISPOSAL METHOD. Contact The Dow Chemical Company for further instructions.

6. HEALTH HAZARD DATA:

**EYE** May cause pain, lachrymation (tears), and severe irritation with corneal injury which may result in permanent impairment of vision, even blindness

**SKIN CONTACT** Short single exposure may cause severe skin burns

**SKIN ABSORPTION** A single prolonged exposure is not likely to result in the material being absorbed through skin in harmful amounts The dermal LD50 has not been determined

**INGESTION** Ingestion may cause gastrointestinal irritation or ulceration and severe burns of the mouth and throat

**INHALATION** Excessive vapor concentrations are readily attainable and may cause serious adverse effects, even death Excessive exposure may cause severe irritation and injury to upper respiratory tract and lungs

**SYSTEMIC & OTHER EFFECTS** Repeated excessive exposures may cause erosion of teeth and bleeding and ulceration of nose, mouth and gums Did not cause cancer in long term animal studies

## **7 FIRST AID**

**EYES** Immediate and continuous irrigation with flowing water at least 30 minutes is imperative Prompt medical consultation is essential

**SKIN** Immediate continued and thorough washing in flowing water for 30 minutes is imperative while removing contaminated clothing Prompt medical consultation is essential

**INGESTION** Do not induce vomiting Give large amounts of water or milk if available and transport to medical facility

**INHALATION** Remove to fresh air If not breathing, give mouth-to-mouth resuscitation If breathing is difficult, give oxygen Call a physician

**NOTE TO PHYSICIAN.** Corrosive May cause stricture If lavage is performed, suggest endotracheal and/or esophagoscopy control If burn is present, treat as any thermal burn, after decontamination. No specific antidote Supportive care Treatment based on judgment of the physician in response to reactions of the patient

## **8 HANDLING PRECAUTIONS**

**EXPOSURE GUIDELINE(S)** ACGIH TLV and OSHA PEL are 5 ppm ceiling

**VENTILATION:** Control airborne concentrations below the exposure guideline. Use only with adequate ventilation Local exhaust ventilation may be necessary for some operations

**RESPIRATORY PROTECTION** When airborne exposure guidelines and/or comfort levels may be exceeded, use an approved air-purifying respirator For emergency and other conditions where the exposure guideline may be greatly exceeded, use an approved positive-pressure self-contained breathing apparatus

**SKIN PROTECTION** Use protective clothing impervious to this material Selection of specific items such as gloves, boots, apron, or full-body suit will depend on operation Safety shower should be located in immediate work area Wash contaminated clothing before reuse Dispose of contaminated

shoes

**EYE PROTECTION:** Use chemical goggles. If vapor exposure causes eye irritation, use a full-face respirator. Wear a face-shield which allows use of chemical goggles, or a full-face respirator, to protect face and eyes when there is any likelihood of splashes. Eye wash fountain and safety shower should be located in immediate work area.

## 9 ADDITIONAL INFORMATION.

**SPECIAL PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE.** Prevent all contact with eyes and skin. Avoid breathing irritating vapors

**MSDS STATUS.** Reviewed, revised section 9 and reissued.

**REGULATORY INFORMATION:** (Not meant to be all-inclusive--selected regulations represented).

**NOTICE:** The information herein is presented in good faith and believed to be accurate as of the effective date shown above. However, no warranty, express or implied, is given. Regulatory requirements are subject to change and may differ from one location to another, it is the buyer's responsibility to ensure that its activities comply with federal, state or provincial, and local laws. The following specific information is made for the purpose of complying with numerous federal, state or provincial, and local laws and regulations. See MSD Sheet for health and safety information

### U.S. REGULATIONS

**SARA 313 INFORMATION:** This product contains the following substances subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372:

CHEMICAL NAME	CAS NUMBER	CONCENTRATION
HYDROCHLORIC ACID	007647-01-0	36 4

**SARA HAZARD CATEGORY:** This product has been reviewed according to the EPA "Hazard Categories" promulgated under Sections 311 and 312 of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III) and is considered, under applicable definitions, to meet the following categories:

An immediate health hazard  
A delayed health hazard

### CANADIAN REGULATIONS

**WEMIS INFORMATION:** The Canadian Workplace Hazardous Materials Information System (WEMIS) Classification for this product is

D1A  
E

**CANADIAN TDG INFORMATION:** For guidance, the Transportation of Dangerous

Goods Classification for this product is

Hydrochloric Acid/Class 8, (9 2)/UN1789/II/ERP2-0011

3

----- NOTICE -----

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-----  
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\* \* \* E N D O F M S D S \* \* \*



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 Phillipsburg, NJ 08865  
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 National Response Center 800-424-8902  
 Chemtrec 800-424-8900

National Response in Canada  
 CANUTEC 613-896-6666  
 Outside U.S. and Canada  
 Chemtrec 202-483-7616

**MATERIAL SAFETY DATA SHEET**  
 NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers are to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals. All non-emergency questions should be directed to Customer Service (1-800-JTBAKER) for assistance.

N3660 -12  
 Effective 09/15/95

Nitric Acid

Page: 1  
 Issued: 04/03/96

Mallinckrodt Baker, Inc., 222 Red School Lane, Phillipsburg, NJ 08865

## SECTION I - PRODUCT IDENTIFICATION

Product Name: Nitric Acid  
 Common Synonyms: Hydrogen Nitrate; Azotic Acid  
 Chemical Family: Inorganic Acids  
 Formula:  $\text{HNO}_3$   
 Formula Wt.: 63.01  
 CAS No.: 7697-37-2  
 NIOSH/RTCS No: Q05775000  
 Product Use: Laboratory Reagent  
 Product Codes: 9804, 9801, 5371, 9816, 5555, 9800, 9597, 9801, 5113, 9806, 9807, 9802, 4801, 9805, 9598, 5801, 5876

## PRECAUTIONARY LABELING

BAKER SAF-T-DATA\* System



Laboratory Protective Equipment



## U.S. Precautionary Labeling

**POISON! DANGER!**

HARMFUL IF INHALED AND MAY CAUSE DELAYED LUNG INJURY. LIQUID AND VAPOR CAUSE SEVERE BURNS. MAY BE FATAL IF SWALLOWED OR INHALED. STRONG OXIDIZER. CONTACT WITH COMBUSTIBLE MATERIALS, FLAMMABLE MATERIALS, OR POWDERED METALS CAN CAUSE FIRE OR EXPLOSION. SPILLAGE MAY CAUSE FIRE OR LIBERATE DANGEROUS GAS. Keep from contact with clothing and other combustible materials. Do not store near combustible materials. Do not get in eyes, on skin, on clothing. Do not breathe vapor. Keep in tightly closed container. Use with adequate ventilation. Wash thoroughly after handling. In case of fire, use water

Continued on Page: 2





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N3660 -12

Effective. 09/15/95

Nitric Acid

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Issued 04/03/96

=====

**PRECAUTIONARY LABELING (CONTINUED)**

=====

spray In case of spill, neutralize with soda ash or lime

International Labeling

Causes severe burns

Keep out of reach of children Do not breathe vapor In case of contact with eyes, rinse immediately with plenty of water and seek medical advice Take off immediately all contaminated clothing

SAF-T-DATA\* Storage Color Code Yellow (reactive)

=====

**SECTION II - COMPONENTS**

=====

Component	CAS No	Weight %	OSHA/PEL	ACGIH/TLV
Nitric Acid	7697-37-2	65-70	2 ppm	2 ppm
Water	7732-18-5	29-35	N/E	N/E

=====

**SECTION III - PHYSICAL DATA**

=====

Boiling Point 121°C (249°F)  
 (at 760 mm Hg)

Vapor Pressure (mmHg) 9  
 (20°C)

Melting Point -42°C (-43°F)  
 (at 760 mm Hg)

Vapor Density (air=1) N/A

Specific Gravity 1.41  
 (H<sub>2</sub>O=1)

Evaporation Rate N/A

Solubility(H<sub>2</sub>O) Complete (100%)

% Volatiles by Volume 100  
 (21°C)

pH 1.0 (0.1M solution)

Odor Threshold (ppm) 0.27

Physical State Liquid

Coefficient Water/Oil Distribution N/A

Appearance & Odor Clear colorless liquid Suffocating odor



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NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers are to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals. All non-emergency questions should be directed to Customer Service (1-800-ITRAKES) for assistance.

## MATERIAL SAFETY DATA SHEET

N3860 -12  
Effective: 09/15/95

Nitric Acid

Page: 3  
Issued: 04/03/96

## SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point (Closed Cup): N/A

NFPA 704M Rating: 3-0-0 OXY

Autoignition Temperature: N/A

Flammable Limits: Upper - N/A Lower - N/A

Fire Extinguishing Media

Use water, dry chemical, or soda ash.

Special Fire-Fighting Procedures

Firefighters should wear proper protective equipment and self-contained breathing apparatus with full facepiece operated in positive pressure mode. Move exposed containers from fire area if it can be done without risk. Use water to keep fire-exposed containers cool; do not get water inside containers.

Unusual Fire & Explosion Hazards

Strong oxidizer. Contact with combustible materials, flammable materials, or powdered metals can cause fire or explosion. Reacts with most metals to produce hydrogen gas, which can form an explosive mixture with air. A violent exothermic reaction occurs with water. Sufficient heat may be produced to ignite combustible materials.

Toxic Gases Produced

oxides of nitrogen, hydrogen

Explosion Data-Sensitivity to Mechanical Impact

None identified.

Explosion Data-Sensitivity to Static Discharge

None identified.

## SECTION V - HEALTH HAZARD DATA

Threshold Limit Value (TLV/TWA): 5.2 mg/m<sup>3</sup> (2 ppm)

Short-Term Exposure Limit (STEL): 10 mg/m<sup>3</sup> (4 ppm)

Permissible Exposure Limit (PEL): 5 mg/m<sup>3</sup> (2 ppm)

Toxicity of components



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24-Hour Emergency Telephone 908-859-2151  
National Response Center 800-424-8802  
Chemtrec 800-424-9300

National Response in Canada  
CANUTEC 613-996-6666  
Outside U.S. and Canada  
Chemtrec 202-483-7616

**MATERIAL SAFETY DATA SHEET**

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**SECTION V - HEALTH HAZARD DATA (CONTINUED)**

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Inhalation-1Hr Rat LC <sub>50</sub> for Nitric Acid	2500 ppm
Unreported route, man, LD <sub>Lo</sub> Nitric Acid	110 mg/kg
Oral human TDLo Nitric Acid	430 mg/kg
Intraperitoneal Mouse LD <sub>50</sub> for Water	190 g/kg
Intravenous Mouse LD <sub>50</sub> for Water	25 g/kg
Carcinogenicity NTP No IARC No Z List No OSHA Reg No	

Carcinogenicity

None identified

Reproductive Effects

None identified

Effects of Overexposure

<b>INHALATION</b>	severe irritation or burns of respiratory system, coughing, difficult breathing, chest pains, pulmonary edema, lung inflammation, unconsciousness, and may be fatal
<b>SKIN CONTACT</b>	severe irritation or burns
<b>EYE CONTACT</b>	severe irritation or burns
<b>SKIN ABSORPTION</b>	none identified
<b>INGESTION</b>	nausea, vomiting, severe burns, ulceration - mouth, throat, stomach, and may be fatal
<b>CHRONIC EFFECTS</b>	damage to lungs, teeth

Target Organs

eyes, skin, mucous membranes, respiratory system, lungs, teeth, GI tract

Medical Conditions Generally Aggravated by Exposure

damaged skin, eye disorders, cardiopulmonary disease, lung disease

Primary Routes of Entry

inhalation, ingestion, eye contact, skin contact



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**MATERIAL SAFETY DATA SHEET**

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\*\*\*\*\*  
**SECTION V - HEALTH HAZARD DATA (CONTINUED)**  
\*\*\*\*\*

**Emergency and First Aid Procedures**

- INGESTION:** CALL A PHYSICIAN. If swallowed, do NOT induce vomiting. If conscious, give water, milk, or milk of magnesia.
- INHALATION:** If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Prompt action is essential.
- SKIN CONTACT:** In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before re-use.
- EYE CONTACT:** In case of eye contact, immediately flush with plenty of water for at least 15 minutes.

**SARA/TITLE III HAZARD CATEGORIES and LISTS**

Acute. Yes Chronic. Yes Flammability: No Pressure: No Reactivity: Yes

Extremely Hazardous Substance: Yes Contains Nitric Acid (RQ = 1,000 LBS, TPQ = 1,000 LBS)

CERCLA Hazardous Substance: Yes Contains Nitric Acid (RQ = 1000 LBS)

SARA 313 Toxic Chemicals: Yes Contains Nitric Acid

Generic Class Generic Class Removed from CFR: 7/1/91

TSCA Inventory: Yes

\*\*\*\*\*  
**SECTION VI - REACTIVITY DATA**  
\*\*\*\*\*

Stability: Stable Hazardous Polymerization: Will not occur

Conditions to Avoid: heat, light, moisture.

Incompatibles: strong bases, carbonates, sulfides, cyanides, combustible materials, organic materials, strong reducing agents, most common metals, powdered metals, carbides, ammonium hydroxide, water, alcohols

Decomposition Products: oxides of nitrogen, hydrogen



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**SECTION VII - SPILL & DISPOSAL PROCEDURES**

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Steps to be Taken in the Event of a Spill or Discharge

Wear self-contained breathing apparatus and full protective clothing  
Stop leak if you can do so without risk Ventilate area Neutralize  
spill with soda ash or lime With clean shovel, carefully place material  
into clean, dry container and cover, remove from area Flush spill area  
with water  
Prevent run-off from entering drains, sewers, or streams  
Keep combustibles (wood, paper, oil, etc ) away from spilled material

J T Baker NEUTRASORB<sup>R</sup> or TEAM<sup>R</sup> 'Low Na+' acid neutralizers are recommended  
for spills of this product

Disposal Procedure

Dispose in accordance with all applicable federal, state, and local  
environmental regulations

EPA Hazardous Waste Number D002, D003 (Corrosive, Reactive Waste)

Aquatic Toxicity

Mosquito Fish 96 Hr-TLm = 72 mg/L

=====

**SECTION VIII - INDUSTRIAL PROTECTIVE EQUIPMENT**

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Ventilation	Use general or local exhaust ventilation to meet TLV requirements
Respiratory Protection	At any detectable concentration, any self-contained breathing apparatus that has a full facepiece and is operated in a pressure- demand or other positive-pressure mode
Eye/Skin Protection	Safety goggles and face shield, uniform, protective suit, neoprene gloves are recommended

=====

**SECTION IX - STORAGE AND HANDLING PRECAUTIONS**

=====

SAF-T-DATA\* Storage Color Code Yellow (reactive)

Storage Requirements

Keep container tightly closed Store separately and away from flammable and combustible materials Isolate from incompatible materials Keep product out of light



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## MATERIAL SAFETY DATA SHEET

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## SECTION IX - STORAGE AND HANDLING PRECAUTIONS (CONTINUED)

Special Precautions

Nitric acid increases the flammability of, and can ignite many organic materials such as wood, solvents, etc., and can release toxic oxides of nitrogen. In addition certain mixtures of strong nitric acid with benzene, 1,2-dichloroethane, or dichloromethane may be detonatable. Spillage may cause fire.

## SECTION X - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

Domestic (D.O.T.)

Proper Shipping Name: Nitric acid (other than red fuming, with not more than 70 percent nitric acid)

Hazard Class: 8

UN/NA: UN2031 Reportable Quantity: 1000 LBS. Packaging Group: II

Labels: 8 CORROSIVE

Regulatory References: 49CFR 172.101

International (I.M.O.)

Proper Shipping Name: NITRIC ACID (other than red fuming, all concentrations)

Hazard Class: 8 I.M.O. Page: 8195

UN: UN2031 Marine Pollutants: No Packaging Group: II

Labels: 8 CORROSIVE

Regulatory References: 49CFR PART 176, IMDG Code

AIR (I.C.A.O.)

Proper Shipping Name: NITRIC ACID, other than red fuming, with not more than 70 percent nitric acid

Hazard Class: 8

UN: UN2031 Packaging Group: II

Labels: 8 CORROSIVE

Regulatory References: 49CFR PART 175; ICAO=== We believe the transportation data and references contained herein to be factual and the opinion of qualified experts. The data is meant as a guide to the overall classification of the product and is not package size specific, nor should it be taken as a warranty or representation for which the company assumes legal responsibility.=== The information is offered solely for your consideration, investigation, and verification. Any use of the information must be determined by the user to be in accordance with applicable Federal, State, and Local



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**MATERIAL SAFETY DATA SHEET**

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Nitric Acid

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## SECTION X - TRANSPORTATION DATA AND ADDITIONAL INFORMATION (CONTINUED)

laws and regulations See shipper requirements 49CFR  
171 2, Certification 172 204, and employee training 49  
CFR 173 1(b)

U S Customs Harmonization Number 28080000000

NOTE When handling liquid products, secondary protective containers must be  
used for carrying

-N/A = Not Applicable, or not Available, -N/E = Not Established

Mallinckrodt Baker provides the information contained herein in good faith but  
makes no representation as to its comprehensiveness or accuracy This  
document is intended only as a guide to the appropriate precautionary handling  
of the material by a properly trained person using this product Individuals  
receiving the information must exercise their independent judgment  
in determining its appropriateness for a particular purpose

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Note CHEMTREC, CANUTEC and NATIONAL RESPONSE CENTER emergency  
telephone numbers are to be used ONLY in the event of **CHEMICAL EMERGENCIES**  
involving a spill, leak, fire, exposure, or accident involving  
chemicals All non-emergency questions should be directed to Customer  
Service (1-800-JTBAKER) for assistance

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**PRODUCT SAFETY  
DATA SHEET**
**SODIUM HYDROXIDE, PELLETS**

<b>TRADE NAME (COMMON NAME)</b> SODIUM HYDROXIDE, PELLETS (various grades)		<input checked="" type="checkbox"/> CAS No. <input type="checkbox"/> GENERAL PRODUCT CODE # 1510-73-2	
<b>CHEMICAL NAME AND/OR SYNONYM</b> Sodium Hydroxide. Synonyms caustic soda; lye; caustic soda. Lead, dry, granular or solid.			
<b>FORMULA</b> NaOH		<b>MOLECULAR WEIGHT</b> 40.00	
<b>ADDRESS (NO. STREET, CITY STATE AND ZIP CODE)</b> GENERAL CHEMICAL CORPORATION CN 1529 Morristown, N.J. 07960-1529			
<b>CONTACT</b> Director of Environmental Matters	<b>PHONE NUMBER</b> (201) 455-5830	<b>LAST ISSUE DATE</b>	<b>CURRENT ISSUE DATE</b> October, 1988

<b>EMERGENCY PHONE NUMBER</b> (201) 455-5700	
<p><b>Eyes</b> Immediately flush with large amounts of water for at least 15 minutes, holding eyelids apart to facilitate irrigation. Utmost speed is essential. Call a physician. If none is available, irrigate another 15-30 minutes before moving patient to a medical facility. Have an ophthalmologist make an evaluation of eye injury.</p> <p><b>Skin</b> Immediately flush under safety shower. If wearing goggles, flush head and face thoroughly before removing goggles. Next, wash victim's hands until all chemical is removed. Then remove contaminated clothing and shoes. Call a physician. Continue washing for one or two hours and remove to a medical facility if a physician is not available (but only after at least one hour of showering).</p> <p><b>Inhalation</b> Remove to fresh air (to be handled by protected personnel). If breathing is difficult, or if cyanotic (blue skin) give oxygen if a qualified operator is available. Arrange for medical help.</p> <p><b>Ingestion</b> Do not induce vomiting. If possible, and if conscious, immediately give large quantities of water or milk. This may be followed with dilute vinegar or fruit juice to neutralize alkali. Arrange for immediate medical help.</p>	

**HEALTH**

<b>INHALATION</b> Inhalation of mist or dust can injure the entire respiratory tract with painful and corrosive action on tissue. Irritation estimated to become noticeable at 2 mg/cu.m. in air. The effects of inhalation vary, depending upon extent of exposure, from mild mucous membrane irritation to sudden, severe bronchopneumonia.	
<b>INGESTION</b> Severe and rapid corrosive burns of mouth, gullet and gastrointestinal tract will result, if swallowed. Effects include severe pain, difficulty in breathing, vomiting, diarrhea, collapse. Some effects may be delayed. Estimated average fatal dose 5 g. (human, adult) - [Ref. (c), Section J]. LD <sub>50</sub> (pr-mus) 40 mg/kg - Ref. (e), Section J.	
<b>SKIN</b> Severe and rapid corrosion from contact. Extent of damage depends on duration of contact. Even dilute solutions exert a destructive effect, following prolonged contact. Mist of many solutions is extremely corrosive.	
<b>EYES</b> Contact rapidly causes severe damage. Permanent corneal damage almost inevitably results. Even dilute solutions may produce similar effects, although less rapidly. Mist of many solutions is extremely corrosive.	
<b>PERMISSIBLE CONCENTRATION: AIR</b> (SEE SECTION 8)	<b>BIOLOGICAL</b> None established.
<b>OSHA/TWA: 2 mg/cu.m. (as 100%)</b> <b>ACGIH/TLV: 2 mg/cu.m. (ceiling value, as 100%)</b>	
<b>UNUSUAL CHRONIC TOXICITY</b> None reported.	



## C. HAZARDS (CONT.)

### FIRE AND EXPLOSION

FLASH POINT	OC	AUTO IGNITION TEMPERATURE	OC	FLAMMABLE (LIMITS IN AIR (% BY VOL.))
No flash point		Not applicable		LOWER — Not applicable UPPER — Not applicable
<input type="checkbox"/> OPEN CUP <input type="checkbox"/> CLOSED CUP				
UNUSUAL FIRE AND EXPLOSION HAZARDS Will react with metals such as aluminum, tin, and zinc (and alloys of these metals) to generate hydrogen gas a fire and explosive hazard. Some material may vaporize in a fire. Contact with water or moisture may generate sufficient heat to ignite combustible materials.				

## D. PRECAUTIONS PROCEDURES

FIRE EXTINGUISHING AGENTS RECOMMENDED	
If involved in a fire flood with water taking care not to splash or scatter this material and keeping it away from common metals (see Section C. above)	
FIRE EXTINGUISHING AGENTS TO AVOID	
Carbon dioxide because it reacts exothermically with this material	
SPECIAL FIRE FIGHTING PRECAUTIONS	
Firefighters should wear self-contained NIOSH-approved breathing apparatus and full protective clothing including eye protection and boots, to protect against vaporized material and mist. Material can melt in a fire and molten material can react violently with small amounts of water (splattering or misting) and with certain common metals to liberate flammable hydrogen gas.	
VENTILATION	
No particular problems with the pellets as sold. If made into a solution and misty conditions are generated or if solid should be ground up and dust is generated provide local exhaust. In the absence of mist or dust, natural ventilation is adequate. Ventilation facilities should be of corrosion-resistant construction. (continued see Section K)	
NORMAL HANDLING	
Do not get in eyes on skin or clothing. Avoid breathing dust or mist, if generated. Keep container closed when not in use. Use with adequate ventilation and wash thoroughly after handling. When making solutions, use sufficient agitation and cooling, while adding slowly to surface of solution to avoid splattering. Avoid handling conditions that may lead to spills, leaks, ejections or to the formation of dust or mist.	
STORAGE	
Store in closed containers in a dry well-ventilated area, separate from acids, peroxides, metals, easily ignitable materials and other incompatibles. Protect against moisture and water, protect against physical damage. (continued see Section K)	
SPILL OR LEAK (ALWAYS WEAR PERSONAL PROTECTIVE EQUIPMENT - SECTION E)	
Clean-up personnel need protection against inhalation and/or skin and eye contact hazards. Dry product can be promptly shoveled up for recovery or disposal. (CAUTION! Avoid dusting and skin and eye contact. Also, delay in clean-up may allow absorption of moisture from the atmosphere increasing clean-up difficulties.) Control the disposal of the waste solid. Flush contaminated surfaces with water and neutralize with dilute acid (preferably acetic acid) to remove final traces. (Sodium bicarbonate may also be used to partially neutralize.) Finally rinse with water attempt to keep out of sewer. Any release to the environment of this product may be subject to federal and/or state reporting requirements. Check with appropriate agencies.	
SPECIAL PRECAUTIONS/PROCEDURES/LABEL INSTRUCTIONS	
Workers should not be permitted to handle this material without proper training and protective equipment. Equipment used with solutions of this material should not be made of soft iron, copper, tin, aluminum, zinc, or alloys of these metals. All equipment should be frequently inspected for leaks and any potential problems.	
SIGNAL WORD -- DANGER!	

## E. PERSONAL PROTECTIVE EQUIPMENT

RESPIRATORY PROTECTION	
In the absence of dust or mist none generally required. For airborne levels of concern use a NIOSH-approved, full facepiece (for eye protection) with a high-efficiency particulate or supplied-air respirator, or a self-contained breathing apparatus.	
EYES AND FACE	
Wear chemical safety goggles if there is any possibility of contact with liquid or mist with the eyes. Add a face shield if there is any possibility of contact with liquid with face. Do not wear contact lenses if handling liquid or dusty solid material.	
HANDS, ARMS, AND BODY	
Wear protective gloves and full protective clothing (preferably made of rubber, neoprene or NBR) if there is any possibility of contact with pellets, dust, liquid or mist. Promptly wash any contaminated impervious items and remove immediately any non-impervious items that become contaminated.	
OTHER CLOTHING AND EQUIPMENT	
Add a hard hat and impermeable boots (made of the same preferred materials listed above) under the same conditions as for gloves and protective clothing. Safties accessible to areas of use and handling. Arrange for neutralization supplies and equipment and abundant running water.	

**PHYSICAL DATA**

<b>MATERIAL IS AT NORMAL CONDITIONS:</b> <input type="checkbox"/> LIQUID <input checked="" type="checkbox"/> SOLID <input type="checkbox"/> GAS <input type="checkbox"/> _____		<b>APPEARANCE AND ODOR:</b> White pellets with no odor    Hygroscopic.	
<b>BOILING POINT</b> 1390 °C <b>MELTING POINT</b> 318 °C	<b>SPECIFIC GRAVITY</b> (H <sub>2</sub> O = 1) (solid) 2.13 (@ 25°C)	<b>VAPOR DENSITY</b> (AIR = 1) Not applicable (Vapor negligible at ambient conditions.)	
<b>SOLUBILITY IN WATER</b> (g by Weight) 29.8 @ 0°C.	<b>pH</b> 5% solution 14	<b>VAPOR PRESSURE</b> (mm Hg at 20°C) <input type="checkbox"/> <b>OR</b> <input type="checkbox"/> Negligible. (1 mm Hg @ 739°C.)	
<b>EVAPORATION RATE</b> (Gross Area = 1) <input type="checkbox"/> (Other = 1) <input type="checkbox"/> Negligible at ambient conditions.	<b>% VOLATILES BY VOLUME</b> (at 20°C) Negligible at ambient conditions.		

**HAZARD DATA**

<b>STABILITY</b> <input type="checkbox"/> UNSTABLE <input checked="" type="checkbox"/> STABLE	<b>CONDITIONS TO AVOID</b> Rapidly absorb carbon dioxide and moisture from the air
<b>INCOMPATIBILITY MATERIALS TO AVOID</b> Common metals and their alloys (see Section 1) acids and their anhydrides, easily oxidizable compounds, including explosives, aldehydes and unsaturated organics, nitro compounds and chlorocarbons. Strong exothermic reaction with water or moisture (generates much heat)	
<b>HAZARDOUS DECOMPOSITION PRODUCTS</b> None Remains chemically unchanged even at boiling temperature	
<b>HAZARDOUS POLYMERIZATION</b> <input type="checkbox"/> MAY OCCUR <input checked="" type="checkbox"/> WILL NOT OCCUR	<b>CONDITIONS TO AVOID</b> None known

**HAZARDOUS INFORMATION**

MATERIAL OR COMPONENT I.C.A.S. #	WT %	HAZARD DATA (SEE SECT J)
Not applicable.		

# I. ENVIRONMENTAL

<b>DEGRADABILITY/AQUATIC TOXICITY</b> Degradability not applicable (inorganic) Aquatic toxicity 125 ppm/96 hr./mosquito fish/TL <sub>m</sub> /fresh water 180 ppm/23 hr./oysters/lethal/salt water [Ref (d)]		<b>OCTANOL/WATER PARTITION COEFFICIENT</b> Unknown.
<b>EPA HAZARDOUS SUBSTANCE?</b> (CLEAN WATER ACT SECT 311) <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	IF SO REPORTABLE QUANTITY: 1000 #	40 CFR 116 117
<b>WASTE DISPOSAL METHODS (DISPOSER MUST COMPLY WITH FEDERAL, STATE AND LOCAL DISPOSAL OR DISCHARGE LAWS)</b> Waste Sodium Hydroxide pellets may be handled by first reducing to an aqueous solution by adding to water with care neutralizing as per Spill or Leak procedures (Section D) and flushed to sewer with lots of water (regulations permitting) or disposed of through a licensed contractor. Since disposal may be subject to federal, state or local regulations (EPA corrosive waste dry or solution forms) users should review their operations in terms of applicable federal, state and local laws and regulations then consult with appropriate regulatory agencies before discharging or disposing of waste material.		
<b>RCRA STATUS OF UNREMOVED MATERIAL IF DISCARDED</b> EPA "hazardous waste" (corrosive) if discarded		<b>HAZARDOUS WASTE NUMBER (IF APPLICABLE)</b> D002 40 CFR 261

# J. REFERENCES

<b>PERMISSIBLE CONCENTRATION REFERENCES</b> TWA OSHA regulation 29 CFR 1910 1000 (19 TLV ACGIH 1985-86 List "Threshold Limit V 'Z List" and Biological Exposure Indices '		
<b>REGULATORY STANDARDS</b> DOT classification Hazardous Materials Table	<b>D.O.T CLASSIFICATION</b> Corrosive material I D No UN1823 CFR 172.101	49 CFR 173
<b>GENERAL</b> (a) NIOSH/OSHA "Pocket Guide to Chemical Hazards", 1985 (b) Gosselin R E et al, "Clinical Toxicology of Commercial Products" 4th ed (1976) Section III pp 206-212 The Williams and Wilkins Co Baltimore (c) Dreisbach R H "Handbook of Poisoning" 4th ed., 1980, Lange Medical Publications Los Altos CA (d) U.S. Coast Guard CHRIS Manual, Entry Sodium Hydroxide (e) NIOSH Registry (RTECS) 1981-82, Accession No WB4900000 (Sodium Hydroxide)		

# K. ADDITIONAL INFORMATION

<b>SECTION D - PRECAUTIONS/PROCEDURES</b> continued <b>Ventilation</b> - continued In the event hydrogen gas is generated (see Section C) a severe ventilation problem is rapidly introduced. Smothering with CO <sub>2</sub> coupled with good local ventilation or respiratory protection, is probably the best emergency action. In this situation ventilation facility must be explosion-resistant if such an emergency is likely to happen. <b>Storage</b> - continued Drains for storage or use areas for this material should have retention basins for pH adjustment and dilutions of spills and flushings before discharge.
--

PDS FILE NO GC-3015

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001 03/22/94 Sulfuric Acid, 77 to 100%

**PRODUCT NAME.**

Sulfuric Acid, 77 to 100%

MSDS # DQ4950CR

**01 CHEMICAL PRODUCT/COMPANY IDENTIFICATION**

**Material Identification**

CAS Number	7664-93-9
Formula	H2SO4
Molecular Weight	98 08
CAS Name	SULFURIC ACID

**02 COMPOSITION/INFORMATION ON INGREDIENTS**

**Components**

Material	CAS Number	%
SULFURIC ACID	7664-93-9	
60 DEG TECHNICAL		77.7
66 DEG TECHNICAL		93 2
1 835 ELECTROLYTE		93 2
98% TECHNICAL		98
99% TECHNICAL		99
100% TECHNICAL		100
WATER	7732-18-5	0-22

Regulated as a Toxic Chemical under Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR part 372

**03 HAZARDS IDENTIFICATION**

**# Potential Health Effects**

Causes severe burns to eyes, skin, and all body tissue. Eye damage may be permanent. Destruction of tissue may result from direct chemical reaction with tissue, from thermal burns, and from dehydration (removal of water) of the tissue

**HUMAN HEALTH EFFECTS:**

Human health effects of overexposure to the liquid by skin or eye contact may cause eye corrosion with corneal or conjunctival ulceration; or skin burns or ulceration. Ingestion of the liquid may cause severe burns to the mucous membranes of the mouth and esophagus. Repeated or prolonged contact with mists may cause eye irritation with discomfort, tearing or blurring of vision; or skin irritation with discomfort or rash. Overexposure by inhalation may include irritation of the upper respiratory passages or erosion of dental surfaces. Higher inhalation exposures may lead to temporary lung irritation effects with cough, discomfort, difficulty breathing, or shortness of breath; or possibly modest initial symptoms followed in hours by severe shortness of breath, requiring prompt medical attention.

The International Agency for Research on Cancer (IARC) classified "strong inorganic acid mists containing sulfuric acid" as a Category 1 carcinogen, a substance that is

"carcinogenic to humans" This classification is for inorganic acid mists only and does not apply to sulfuric acid or sulfuric acid solutions. The basis for the IARC classification rests on several epidemiology studies which have several deficiencies. These studies did not account for exposure to other substances, some known to be animal or potential human carcinogens, social influences (smoking or alcohol consumption) and included small numbers of subjects. Based on the overall weight of evidence from all human and chronic animal studies, no definitive causal relationship between sulfuric acid mist exposure and respiratory tract cancer has been shown.

Individuals with preexisting diseases of the lungs may have increased susceptibility to the toxicity of excessive exposures.

#### Carcinogenicity Information

None of the components present in this material at concentrations equal to or greater than 0.1% are listed by IARC, NTP, OSHA or ACGIH as a carcinogen.

#### 04 FIRST AID MEASURES

##### First Aid

##### INHALATION

If inhaled, immediately remove to fresh air and have patient lie down and remain quiet. Apply artificial respiration if breathing has stopped. Give oxygen if breathing is difficult. Call a physician.

##### INGESTION

If swallowed, do not induce vomiting. Give large quantities of water. Call a physician. Do not neutralize the acid. Never give anything by mouth to an unconscious person.

##### SKIN OR EYE CONTACT

In case of contact, immediately (within seconds) flush skin or eyes with plenty of water (preferably cold water) for at least 15 minutes while removing contaminated clothing and shoes. Call a physician. Wash clothing before reuse.

While the patient is being transported to a medical facility, apply compresses of iced water. If medical treatment must be delayed, immerse the affected area in iced water. If immersion is not practical, compresses of iced water can be applied. Avoid freezing tissues.

##### Notes to Physicians

Continued washing of the affected area with cold or iced water will be helpful in removing the last traces of sulfuric acid. Creams or ointments should not be applied before or during the washing phase of the treatment.

#### 05 FIRE FIGHTING MEASURES

##### Flammable Properties

Flash Point

Will not burn

## **Fire and Explosion Hazards**

Reacts with most metals, especially when dilute, to give flammable, potentially explosive hydrogen gas. Follow appropriate National Fire Protection Association (NFPA) codes.

### **Extinguishing Media**

Use media appropriate for surrounding material

Use water spray to cool containers exposed to fire; do not get water inside containers

### **Fire Fighting Instructions**

Evacuate personnel to a safe area. Keep personnel removed and upwind of fire. Generates heat upon addition of water, with possible spattering. Wear full protective clothing. Runoff from fire control may cause pollution. Neutralize run-off with lime, soda ash, etc., to prevent corrosion of metals and formation of hydrogen gas. Wear self-contained breathing apparatus if fumes or mists are present

## **06 ACCIDENTAL RELEASE MEASURES**

### **Safeguards (Personnel)**

**NOTE** Review FIRE FIGHTING MEASURES and HANDLING (PERSONNEL) sections before proceeding with clean-up. Use appropriate PERSONAL PROTECTIVE EQUIPMENT during clean-up

### **Accidental Release Measures**

Stop flow if possible. Review "Fire and Explosion Hazards" and "Safety Precautions" before proceeding with clean up. Use appropriate protective equipment during clean up. Soak up small spills with dry sand, clay or diatomaceous earth. Dike large spills, and cautiously dilute and neutralize with lime or soda ash, and transfer to waste water treatment system. Prevent liquid from entering sewers, waterways, or low areas

If this product is spilled and not recovered, or is recovered as a waste for treatment or disposal, the Reportable Quantity is 1,000 lbs. (based on the sulfuric acid content of the solution spilled). Comply with Federal, State, and local regulations on reporting releases

DuPont Emergency Exposure Limits (EEL) are established to facilitate site or plant emergency evacuation and specify airborne concentrations of brief durations which should not result in permanent adverse health effects or interfere with escape. EEL's are expressed as airborne concentration multiplied by time (C<sub>WT</sub>) for up to a maximum of 60 minutes and as a ceiling airborne concentration. These limits are used in conjunction with engineering controls/monitoring and as an aid in planning for episodic releases and spills. For more information on the applicability of EEL's, contact DuPont.

The DuPont Emergency Exposure Limit (EEL) for Sulfuric Acid is 10 mg/m<sup>3</sup> for 15 to 60 minutes and 20 mg/m<sup>3</sup> for up to 15 minutes with a not-to-exceed ceiling of 20 mg/m<sup>3</sup>.

## **07 HANDLING AND STORAGE**

### **Handling (Personnel)**

Do not get in eyes, on skin, or on clothing Avoid breathing vapors or mist Wash thoroughly after handling

Keep containers closed Do not add water to contents while in container because of violent reaction

#### Storage

Keep out of sun and away from heat, sparks, and flame Keep container tightly closed and (drum) closure up to prevent leakage Loosen closure carefully Relieve internal pressure when received and at least weekly thereafter Do not use pressure to empty Be sure closure is securely fastened before moving container Do not wash out container or use it for other purposes, replace closure after each withdrawal and return it with empty container

#### 08 EXPOSURE CONTROLS/PERSONAL PROTECTION

##### Engineering Controls

Good general ventilation should be provided to keep vapor and mist concentrations below the exposure limits

##### Personal Protective Equipment

Have available and wear as appropriate for exposure conditions when handling containers or operating equipment containing sulfuric acid chemical splash goggles, full-length face shield/chemical splash goggles combination, acid-proof gauntlet gloves, apron, and boots, long sleeve wool, acrylic, or polyester clothing, acid proof suit and hood, and appropriate NIOSH/MSHA respiratory protection In case of emergency or where there is a strong possibility of considerable exposure, wear a complete acid suit with hood, boots, and gloves If acid vapor or mist are present and exposure limits may be exceeded, wear appropriate NIOSH/MSHA respiratory protection

#### # Exposure Guidelines

##### Exposure Limits

Sulfuric Acid, 77 to 100%

PEL (OSHA)	1 mg/m3, 8 Hr TWA
TLV (ACGIH)	1 mg/m3, 8 Hr TWA
	STEL 3 mg/m3
AEL (Du Pont)	1 mg/m3, 8 & 12 Hr TWA

AEL is Du Pont's Acceptable Exposure Limit Where governmentally imposed occupational exposure limits which are lower than the AEL are in effect, such limits shall take precedence

#### 09 PHYSICAL AND CHEMICAL PROPERTIES

##### Physical Data

Boiling Point	193-327 C (379-621 F) @ 760 mm Hg
Vapor Pressure	<0.3 mm Hg @ 25 C (77 F)
	<0.6 mm Hg @ 38 C (100 F)
Vapor Density	3.4
Melting Point	-35 to 11 C (-31 to 52 F)
Evaporation Rate	(Butyl Acetate = 1)
	Less than 1
Solubility in Water	100 WT%
pH	Less than 1

Odor  
Form  
Color

Odorless  
Oily, clear to turbid liquid  
Colorless to light gray

GRADE	BOILING PT		MELTING PT.		SPECIFIC GRAVITY <sup>20</sup>
	DEG C	DEG F	DEG C	DEG F	
60 DEG TECHNICAL	193	380	-12	10	1.706
66 DEG TECHNICAL	279	535	-35	-31	1.835
1.835 ELECTROLYTE	279	535	-35		835
98% TECHNICAL	327	621			844
99% TECHNICAL	310				12
100% TECHNICAL					

## 10 STABILITY AND REACTIVITY

### Chemical Stability

Stable, but reacts violently with evolution

### Decomposition

Releases sulfur dioxide at 4

### Polymerization

Polymerization will not occur.

### Other Hazards

**Incompatibility** · Vigorous reactions with water; alkaline solutions; metals, metal powder; carbides; chlorates; fulminates; nitrates; picrates; strong oxidizing, reducing, or combustible organic materials. Hazardous gases are evolved on contact with chemicals such as cyanides, sulfides, and carbides.

## 11 TOXICOLOGICAL INFORMATION

### Animal Data

Inhalation 1-hour LC50: 347 ppm in rats  
Oral LD50 : 2,140 mg/kg in rats

Sulfuric acid is corrosive to the skin and eyes of animals. By ingestion, it is moderately toxic in animals causing corrosion of mucosal surfaces. Toxic effects described in animals from single exposures by inhalation include respiratory irritation. Animal testing indicates that this compound does not have carcinogenic, mutagenic, embryotoxic, or reproductive effects.

## 12 ECOLOGICAL INFORMATION

### Ecotoxicological Information

### Aquatic Toxicity

48-hour TLM, flounder: 100-300 ppm



**13 DISPOSAL CONSIDERATIONS****Waste Disposal**

Cleaned-up material may be an RCRA Hazardous Waste on disposal due to the corrosivity characteristic. Do not flush to surface water or sanitary sewer system. Comply with Federal, State, and local regulations. If approved, neutralize and transfer to waste treatment system.

**14 TRANSPORTATION INFORMATION****Shipping Information**

DOT/IMO	
Proper Shipping Name	SULFURIC ACID
Hazard Class	8
UN No	1830
DOT/IMO Label	CORROSIVE
Special Information	DOT/IMO PLACARD CORROSIVE
Packing Group	II

Reportable Quantity 1000 lb

**Shipping Containers**

Tank Cars  
Tank Trucks  
Barge

If material is shipped in quantities greater than 1,000 lbs per container, the Proper Shipping Name is RQ SULFURIC ACID

**15 REGULATORY INFORMATION****U S Federal Regulations**

TSCA Inventory Status	Reported/Included
-----------------------	-------------------

**TITLE III HAZARD CLASSIFICATIONS SECTIONS 311, 312**

Acute	Yes
Chronic	Yes
Fire	No
Reactivity	Yes
Pressure	No

**LISTS**

SARA Extremely Hazardous Substance	-Yes
CERCLA Hazardous Material	-Yes
SARA Toxic Chemicals	-Yes

**16 OTHER INFORMATION****NFPA, NPCA-HMIS**

NFPA Rating	
Health	3
Flammability	0
Reactivity	. 2

**Water Reactive**

NPCA-HMIS Rating	
Health	3
Flammability	0
Reactivity	2

Personal Protection rating to be supplied by user depending on use conditions

#### Additional Information

For further information, see DuPont Sulfuric Acid "Storage and Handling Bulletin".

# Indicates updated section.

End of MSDS

#### ----- NOTICE -----

-----  
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\* \* \* E N D O F M S D S \* \* \*



## INTEROFFICE MEMORANDUM

DATE July 8, 1996  
TO Distribution  
FROM Ricky J Carr, Environmental Safety & Health, Bldg T664A, X2970  
SUBJECT HEAT STRESS - RJC-014-96  
Action None Required

The purpose of this memo is to provide guidance regarding the prevention and monitoring of heat stress conditions. It should be noted that heat stress related conditions or disorders (i.e. heat stroke, heat exhaustion) are considered to be occupational illnesses by OSHA and therefore are recordable cases. It is incumbent to prevent, monitor and mitigate conditions which may lead to heat stress among employees.

There is a draft Heat Stress Program that has been written by Kaiser-Hill L.L.C. (K-H) Industrial Hygiene and Safety and reviewed by the Industrial Hygiene and Safety organizations of the major subcontractors. This Heat Stress Program describes the responsibilities of various personnel regarding implementation of the Program and contains instructions for monitoring heat stress and provides guidelines for Threshold Limit Values (TLVs) and work/rest regimens. DOE Order 440.1, Worker Protection Management for DOE Federal and Contractor Employees requires compliance with the most recent edition of the ACGIH "Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices" when TLVs are more protective than OSHA Permissible Exposure Limit (PELs) (there is no OSHA PEL for heat stress). The work/rest regimens specified in the Heat Stress Program are based upon the ACGIH TLVs modified by professional judgment for the use of impermeable personal protective clothing (PPE). These TLVs assume that the workers exposed to heat stress conditions are acclimatized.

It is (will be) Rocky Mountain Remediation Services (RMRS) policy to adhere the requirements of the Heat Stress Program including the work/rest regimens contained as Appendix 1 of the Program (attached). Prevention of potential heat stress conditions is the first method to be considered when heat stress is identified as a potential hazard associated with any activity or task. Prevention methods to be considered include work schedule modification of task/activity and provision for rest areas. The Heat Stress Program provides instructions for monitoring heat stress conditions using the Wet Bulb Globe Temperature (WBGT) Index. WBGT accounts for air temperature, relative humidity, and solar load and provides a mechanism for correlating environmental conditions with body temperature and other physiological responses to heat stress. The Heat Stress Program contains a Table for work/rest regimens based upon the WBGT Index, work activities, and level of Personal Protective Equipment (PPE). Work/rest regimens shall be established in accordance with guidelines in the Table with the following interpretations. Physiological monitoring (i.e. body temperatures, pulse rates) will be performed whenever practical and feasible in order to verify the work/rest regimens are appropriate considering the WBGT Index. The use of personal cooling devices such as ice vests or vortex cooling can be used to modify the WBGT Index.

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July 8 1996  
Page 2

for a particular work activity and level of PPE The WBGT Index can be lowered by 3°F if a personal cooling device is employed and physiological monitoring is performed to confirm that the personal cooling devices are effective (using the monitoring guidance provided on page 8-21 in the NIOSH/OSHA/USCG/EPA Occupational Safety and Health Guidance Manual for Hazardous Waste Activities) Additional modification to the WBGT Index when personal cooling devices are employed when be evaluated on a case-by-case basis Column 2 will be employed if permeable protective clothing (regardless of respiratory protection) is utilized Permeable protective clothing includes cotton and Kleenguard™ coveralls Column 3 will be employed if semi-permeable protective clothing (Tyvek) is utilized Column 4 will be employed if impermeable protective clothing (Saranex) is utilized

Please distribute this guidance to all personnel that have operations affected by heat stress considerations Please don not hesitate to call if you have questions or comments

RJC clh

Attachment  
As Stated

Distribution

R E Bates  
G W Beers  
R J Carr  
M E Findley  
K D Jenkins  
O McAfee  
R A McCafferty  
A W Medina  
T T Sangaline  
M D Schrenkengast  
T N Timmons

cc

G Agüero  
C A Benson  
C Boardman  
J Chapin  
J A Cuicci  
C S Evans  
R C Fitz  
T D Gray  
L F Johnson  
J E Law  
D E Steffen  
M R Wagner  
M Wheeler  
ESH&Q File  
RMRS Records Center

## RFETS HEAT STRESS PROGRAM

### HEAT STRESS GUIDELINES FOR LIGHT WORK

(1)	(2)	(3)	(4)
WORK/REST	WBGT°F	WBGT°F	WBGT°F
Continuous	86	76	72
75/25%	87	77	73
50/50%	89	78 5	74 5
25/75%	90	79 9	75 9

### HEAT STRESS GUIDELINES FOR MODERATE WORK

(1)	(2)	(3)	(4)
WORK/REST	WBGT°F	WBGT°F	WBGT°F
Continuous	80	70	66
75/25%	82	72 4	68 4
50/50%	85	74 9	70 9
25/75%	88	77 9	73 9

### HEAT STRESS GUIDELINES FOR HEAVY WORK

(1)	(2)	(3)	(4)
WORK/REST	WBGT°F	WBGT°F	WBGT°F
Continuous	77	67	63
75/25%	78	68 6	64 6
50/50%	82	72 2	68 2
25/75%	86	76	72

(1) No Personal Protective Equipment

(2) One pair coveralls (Anti C) modesty garments gloves hood shoe covers (Level D Haz Mat PPE)

(3) Two pair coveralls (Anti C) modesty garments gloves hood shoe covers  
or

One pair coveralls (Anti C) modesty garments gloves hood respirator (Level C Haz Mat PPE)

(4) Two pair coveralls (Anti C) modesty garments gloves hood shoe covers respirator (Level A&B Haz Mat PPE)

Threshold Limit Values Work/Warm up Schedule for Four Hour Shifts

Air Temperature—Sunny Sky		No Noticeable Wind				5 mph Wind		10 mph Wind		15 mph Wind		20 mph Wind	
C (approx )	F (approx )	Max Work Period	No of Breaks	Max Work Period	No of Breaks	Max Work Period	No of Breaks	Max Work Period	No of Breaks	Max Work Period	No of Breaks	Max Work Period	No of Breaks
-26 to -28	-15 to -19°	(Norm Breaks) 1	1	(Norm Breaks) 1	1	75 min	2	55 min	3	40 min	4	30 min	5
-29 to -31	-20° to -24	(Norm Breaks) 1	1	75 min	2	55 min	3	40 min	4	30 min	5	Non emergency work should cease	
-32 to -34	-25 to -29	75 min	2	55 min	3	40 min	4	30 min	5	Non emergency work should cease			
-35 to -37	-30° to -34	55 min	3	40 min	4	30 min	5	Non emergency work should cease					
-38 to -39°	-35 to -39	40 min	4	30 min	5	Non emergency work should cease							
-40° to -42	-40 to -44	30 min	5	Non emergency work should cease									
-43 & below	-45 & below	Non-emergency work should cease											

- Schedule applies to any 4 hour work period with moderate to heavy work activity with warm up periods of ten (10) minutes in a warm location and with an extended break (i.e. lunch) at the end of the 4 hour work period in a warm location. For Light to Moderate Work (limited physical movement) apply the schedule one step lower. For example at -35 C (-30 F) with no noticeable wind (Step 4) a worker at a job with little physical movement should have a maximum work period of 40 minutes with 4 breaks in a 4 hour period (Step 5).
- The following is suggested as a guide for estimating wind velocity if accurate information is not available
  - 5 mph light flag moves 10 mph light flag fully extended 15 mph raises newspaper sheet 20 mph blowing and drifting snow
- If only the wind chill cooling rate is available a rough rule of thumb for applying it rather than the temperature and wind velocity factors given above would be 1) special warm up breaks should be initiated at a wind chill cooling rate of about 1750 W/m<sup>2</sup> 2) all non emergency work should have ceased at or before a wind chill of 2250 W/m<sup>2</sup>. In general the warmup schedule provided above slightly under compensates for the wind at the warmer temperatures assuming acclimatization and clothing appropriate for winter work. On the other hand the chart slightly over compensates for the actual temperatures in the colder ranges because windy conditions rarely prevail at extremely low temperatures.
- TLVs apply only for workers in dry clothing.

# Windchill Index

Wind Speed in mph	ACTUAL THERMOMETER READING (°F)										
	50	40	30	20	10	0	10	20	30	40	
	EQUIVALENT TEMPERATURE (°F)										
calm	50	40	30	20	10	0	10	20	30	40	
5	48	37	27	16	6	5	15	26	36	47	
10	40	28	16	4	9	21	33	46	58	70	
15	36	22	9	5	18	36	45	58	72	85	
20	32	18	4	10	25	39	53	67	82	96	
25	30	16	0	15	29	-44	59	74	88	104	
30	28	13	2	18	33	48	-63	79	94	109	
35	27	11	-4	20	35	49	-67	82	98	113	
40	26	10	6	21	37	53	69	85	-100	116	
Over 40 mph (little added effect)	LITTLE DANGER (for properly clothed person)			INCREASING DANGER (Danger from freezing of exposed flesh)				GREAT DANGER			

Table 1

MW Table 1

CAS Table 1

RTECS Table 1

METHOD 1003, Issue 2		EVALUATION PARTIAL		Issue 1 15 February 1984 Issue 2. 15 August 1994	
OSHA : See TABLE 1 NIOSH: See TABLE 1 ACGIH See TABLE 1			PROPERTIES. See TABLE 2		
COMPOUNDS (synonyms in Table 1)	benzyl chloride bromoform carbon tetrachloride chlorobenzene	chlorobromomethane chloroform o-dichlorobenzene p-dichlorobenzene	1,1-dichloroethane 1,2-dichloroethylene ethylene dichloride hexachloroethane	1,1,1-trichloroethane tetrachloroethylene 1,1,2-trichloroethane 1,2,3-trichloropropane	
SAMPLING			MEASUREMENT		
SAMPLER	SOLID SORBENT TUBE (coconut shell charcoal 100 mg/50 mg)		TECHNIQUE.	GAS CHROMATOGRAPHY FID	
FLOW RATE.	0.01 to 0.2 L/min		ANALYTE:	compounds above	
VOL-MIN MAX.	Table 3 Table 3		DESORPTION	1 mL CS <sub>2</sub> , stand 30 min	
SHIPMENT	routine		INJECTION VOLUME.	5 µL	
SAMPLE STABILITY	not determined		TEMPERATURES.	Table 4	
BLANKS	2 to 10 field blanks per set		CARRIER GAS.	N <sub>2</sub> or He 30 mL/min	
			COLUMN	Table 3, alternates are SP 2100 Sp-2100 with 0.1% Carbowax 1500 or DB-1 fused silica capillary column	
ACCURACY			CALIBRATION	standard solutions of analyte in CS <sub>2</sub>	
RANGE STUDIED	see EVALUATION OF METHOD [1]		RANGE.	Table 4	
BIAS.	see EVALUATION OF METHOD [1]		ESTIMATED LOD	0.01 mg per sample [2]	
OVERALL PRECISION ( $\bar{S}_r$ )	see EVALUATION OF METHOD [1]		PRECISION ( $\bar{S}_r$ )	see EVALUATION OF METHOD	
ACCURACY	see EVALUATION OF METHOD [1]				
APPLICABILITY: See Table 2 for working ranges. This method can be used for simultaneous determination of two or more substances suspected to be present by changing gas chromatographic conditions (i.e. temperature program). High humidity during sampling will prevent organic vapors from being trapped efficiently on the sorbent and greatly decreases breakthrough volume					
INTERFERENCES. None identified The chromatographic column or separation conditions may be changed to circumvent interferences.					
OTHER METHODS. This method combines and replaces P&CAM 127 [3] S101 [4], S110 [5], S113 [6], S114 [7] S115 [8], S122 [9] S123 [10] S126 [11], S133 [12], S134 [13] S135 [14] S281 [15], S314 [16] S328 [17], S335 [18], S351 [19] and Method 1003 (dated 2/15/84)					



**REAGENTS**

- 1 Carbon disulfide chromatographic quality \*
- 2 Analyte reagent grade
- 3 Calibration stock solutions
  - a benzyl chloride 10 mg/mL in n heptane
  - b bromoform 10 mg/mL in n hexane
  - c o-dichlorobenzene 200 mg/mL in acetone
  - d p-dichlorobenzene 300 mg/mL in acetone
  - e hexachloroethane 25 mg/mL in toluene
- 4 Decane n undecane octane or other internal standards (see step 6)
- 5 Nitrogen or helium purified
- 6 Hydrogen prepurified
- 7 Air filtered

• See SPECIAL PRECAUTIONS

**EQUIPMENT**

- 1 Sampler glass tube 7 cm long 6-mm OD 4 mm ID flame sealed ends with plastic caps containing two sections of 20/40 mesh activated (600 °C) coconut shell charcoal (front = 100 mg back = 50 mg) separated by a 2 mm urethane foam plug A silylated glass wool plug precedes the front section and a 3 mm urethane foam plug follows the back section Pressure drop across the tube at 1 L/min airflow must be less than 3.4 kPa Tubes are commercially available (e.g. SKC #226-01)
- 2 Personal sampling pump 0.01 to 0.2 L/min with flexible connecting tubing
- 3 Gas chromatograph FID integrator and column (see Table 3)
- 4 Vials 2 mL, glass PTFE lined septum crimp caps
- 5 Volumetric flasks 10 mL
- 6 Syringes 10 µL, readable to 0.1 µL
- 7 Pipet TD 1 mL, with pipet bulb

**SPECIAL PRECAUTIONS** Carbon disulfide is toxic and a serious fire and explosion hazard (flash point = -30 °C) Work with it only in a hood Several of the analytes are suspect carcinogens (Table 1) n Heptane n hexane and acetone are fire hazards

**SAMPLING**

- 1 Calibrate each personal sampling pump with a representative sampler in line
- 2 Break the ends of the sampler immediately before sampling Attach sampler to personal sampling pump with flexible tubing
- 3 Sample at an accurately known flow rate between 0.01 and 0.2 L/min for a total sample size between the limits shown in Table 2
- 4 Cap the samplers Pack securely for shipment

**SAMPLE PREPARATION**

- 5 Place the front and back sorbent sections of the sampler tube in separate vials Discard the glass wool and foam plugs
- 6 Add 1.0 mL CS<sub>2</sub> to each vial Cap each vial  
NOTE A suitable internal standard such as decane [16] n undecane [6.19] or octane [9.13.17] at 0.1% (v/v) may be added at this step and step 8
- 7 Allow to stand 30 min with occasional agitation

**CALIBRATION AND QUALITY CONTROL**

- 8 Calibrate daily with at least six working standards over the appropriate range (Table 3)
  - a Add known amounts of neat analyte or calibration stock solution to CS<sub>2</sub> in 10 mL volumetric flasks and dilute to the mark.
  - b Analyze with samples and blanks (steps 11 and 12)
  - c Prepare calibration graph (peak area vs. mg analyte)

- 9 Determine desorption efficiency (DE) at least once for each lot of charcoal used for sampling in the range of interest Prepare three tubes at each of five concentrations plus three media blanks.
  - a Remove and discard back sorbent section of a media blank sampler
  - b Inject a known amount (2 to 20  $\mu\text{L}$ ) of pure analyte or calibration stock solution (see REAGENTS 3) directly onto front sorbent section with a microliter syringe
  - c Cap the tube Allow to stand overnight.
  - d Desorb (steps 5 through 7) and analyze together with working standards (steps 11 and 12)
  - e Prepare a graph of DE vs mg analyte recovered
- 10 Analyze three quality control blind spikes and three analyst spikes to insure that the calibration graph and DE graph are in control

## MEASUREMENT

- 11 Set gas chromatograph according to manufacturer's recommendations and to conditions given on page 1003-1 and in Table 3 Inject sample aliquot either manually using solvent flush technique or with autosampler  
NOTE If peak area is above the linear range of the working standards dilute with  $\text{CS}_2$ , reanalyze and apply the appropriate dilution factor in calculations
- 12 Measure peak area.

## CALCULATIONS

- 13 Determine the mass, mg (corrected for DE) of analyte found in the sample front ( $W_f$ ) and back ( $W_b$ ) sorbent sections and in the average media blank front ( $B_f$ ) and back ( $B_b$ ) sorbent sections  
NOTE If  $W_b > W_f/10$  report breakthrough and possible sample loss.
- 14 Calculate concentration  $C$  of analyte in the air volume sampled  $V$  (L)

$$C = \frac{(W_f + W_b - B_f - B_b) \cdot 10^3}{V}, \text{ mg/m}^3$$

## EVALUATION OF METHOD

Laboratory testing was performed with spiked samples and generated atmospheres using SKC Lot 105 coconut shell charcoal [1] Results were

Compound	Range mg/m <sup>3</sup>	Sample Size	Bias %	Precision		Accuracy $\pm\%$	Desorption Efficiency	Ref
				Overall	Measurement			
Benzyl chloride	2-8	10 L	-8.4	0.006	0.031	25.6	0.90 @ 0.03-0.1 mg	[8]
Bromoform	3-10	10 L	-1.3	0.071	0.043	14.0	0.80 @ 0.025 mg	[7]
Carbon tetrachloride	65-299	15 L	-1.6	0.092	0.037	18.0	0.96 @ 1.3-4.8 mg	[16]
Chlorobenzene	183-736	10 L	0.3	0.056	0.025	11.0	0.91 @ 1.6-7.1 mg	[12]
Chlorobromomethane	640-2656	5 L	3.4	0.061	0.051	14.0	0.94 @ 3.3-13 mg	[6]
Chloroform	100-416	15 L	1.3	0.057	0.047	11.6	0.97 @ 1.6-7.4 mg	[19]
<i>o</i> -Dichlorobenzene	150-629	3 L	-1.9	0.068	0.013	13.7	0.86 @ 0.5-1.9 mg	[14]
<i>p</i> -Dichlorobenzene	183-777	3 L	-4.3	0.052	0.022	12.5	0.91 @ 0.7-2.7 mg	[15]
1,1-Dichloroethane	212-838	10 L	2.6	0.057	0.011	12.4	1.01 @ 1.9-8 mg	[10]
1,2-Dichloroethylene*	475-1915	3 L	-2.9	0.052	0.017	11.3	1.00 @ 2.4-9.5 mg	[5]
Ethylene dichloride	195-819	3 L	-2.0	0.079	0.012	15.7	0.96 @ 0.6-2.5 mg	[9]
Hexachloroethane	5-25	10 L	-6.6	0.121	0.014	25.4	0.98 @ 0.05-0.2 mg	[4]
1,1,1-Trichloroethane	904-3790	3 L	-0.6	0.054	0.016	10.6	0.99 @ 2.9-11 mg	[17]
Tetrachloroethylene	655-2749	3 L	-7.2	0.052	0.013	15.1	0.96 @ 2.1-8 mg	[18]
1,1,2-Trichloroethane	26-111	10 L	-9.0	0.057	0.010	17.5	0.97 @ 0.3-1.2 mg	[13]
1,2,3-Trichloropropane	163-629	10 L	2.1	0.068	0.027	14.2	0.95 @ 1.5-6 mg	[11]

\*isomer used (i.e. cis- or trans-) in evaluation unknown

## REFERENCES

- [1] Documentation of the NIOSH Validation Tests S1C S110 S113 S114 S115 S122 S123 S126 S133 S134 S135 S281 S314 S328 S335 S351 U S Department of Health Education and Welfare Publ (NIOSH) 77 185 (1977) available as Stock No PB 274 248 from NTIS Springfield VA 22161
- [2] User check UBTL, NIOSH Sequences #3990 T 3990 U and 3990 W (NIOSH unpublished November 3 1983) and 4304-J (NIOSH unpublished April 3 1984)
- [3] NIOSH Manual of Analytical Methods 2nd ed V 1 P&CAM 127 U S Department of Health Education and Welfare Publ (NIOSH) 77 157 A (1977)
- [4] Ibid V 2 S101 U S Department of Health Education and Welfare Publ (NIOSH) 77 157 B (1977)
- [5] Ibid S110
- [6] Ibid S113
- [7] Ibid S114
- [8] Ibid S115
- [9] Ibid S122
- [10] Ibid S123
- [11] Ibid S126
- [12] Ibid S133
- [13] Ibid S134
- [14] Ibid V 3 S135 U S Department of Health Education and Welfare Publ (NIOSH) 77 157 C (1977)
- [15] Ibid S281
- [16] Ibid S314
- [17] Ibid S328
- [18] Ibid S335
- [19] Ibid S351
- [20] NIOSH/OSHA Occupational Health Guidelines for Chemical Hazards U S Department of Health and Human Services Publ (NIOSH) 81 123 (1981) available as Stock #PB83 154609 from NTIS Springfield VA 22161
- [21] NIOSH Current Intelligence Bulletin 27 Chloroethanes Review of Toxicity U S Department of Health Education and Welfare Publ (NIOSH) 78 181 (1978)
- [22] NIOSH Current Intelligence Bulletin 20 Tetrachloroethylene (Perchloroethylene) U S Department of Health Education and Welfare Publ (NIOSH) 78-112 (1978)
- [23] Criteria for a Recommended Standard Occupational Exposure to Benzyl Chloride U S Department of Health Education and Welfare Publ (NIOSH) 78-182 (1978)
- [24] Criteria for a Recommended Standard Occupational Exposure to Carbon Tetrachloride U S Department of Health Education and Welfare Publ (NIOSH) 76-133 (1976)
- [25] Criteria for a Recommended Standard Occupational Exposure to Chloroform, U S Department of Health Education and Welfare Publ (NIOSH) 75-114 (1975)
- [26] Criteria for a Recommended Standard Occupational Exposure to Ethylene Dichloride U S Department of Health Education and Welfare Publ (NIOSH) 76-139 (1976)
- [27] Criteria for a Recommended Standard Occupational Exposure to 1,1,1-Trichloroethane, U S Department of Health Education and Welfare Publ (NIOSH) 76-184 (1976)
- [28] Criteria for a Recommended Standard Occupational Exposure to Tetrachloroethylene (Perchloroethylene) U S Department of Health Education and Welfare Publ (NIOSH) 76-185 (1976)

## METHOD REVISED BY

G David Foley and Yvonne T Gagnon NIOSH/DPSE methods originally validated under NIOSH Contract CD-99 74-45

TABLE 1 GENERAL INFORMATION

Compound RTECS	Synonyms	OSHA/NIOSH/ACGIH (ppm)
Benzyl chloride <sup>a</sup> (C <sub>6</sub> H <sub>5</sub> CH <sub>2</sub> Cl) XS8925000	(chloromethyl) benzene- o-chlorotoluene CAS #100-44-7	1/C 1.0/1
Bromoform (CHBr <sub>3</sub> ) PB5600000	tribromomethane CAS #75-25-2	0.5 (skin)/0.5 (skin)/0.5 (skin)
Carbon tetrachloride <sup>ab</sup> (CCl <sub>4</sub> ) FG4900000	tetrachloromethane CAS #56-23-5	10, C 25/STEL 2 (1 h)/5 (skin)
Chlorobenzene (C <sub>6</sub> H <sub>5</sub> Cl) CZ0175000	monochlorobenzene phenyl chloride CAS #108-90-7	75/-/10
Chlorobromomethane (CH <sub>2</sub> BrCl) PA5250000	bromochloromethane Halon 1011 CAS #74-87-5	200/200/200
Chloroform <sup>ab</sup> (CHCl <sub>3</sub> ) FS9100000	trichloromethane CAS #67-66-3	C 50/STEL 2/10
o-Dichlorobenzene <sup>c</sup> (1,2-C <sub>6</sub> H <sub>4</sub> Cl <sub>2</sub> ) CZ4500000	1,2-dichlorobenzene CAS #95-50-1	50/C 50/25 (skin) STEL 50
p-Dichlorobenzene <sup>bc</sup> (1,4-C <sub>6</sub> H <sub>4</sub> Cl <sub>2</sub> ) CZ4550000	1,4-dichlorobenzene CAS #106-46-7	75/1.7 (LOQ)/75, STEL 110
1,1-Dichloroethane (CH <sub>3</sub> CHCl <sub>2</sub> ) K00175000	ethylidene chloride CAS #75-34-3	100/100/100
1,2-Dichloroethylene (ClCH=CHCl) KV9360000	acetylene dichloride 1,2-dichloroethene CAS #540-59-0	200/200/200
Ethylene dichloride <sup>ab</sup> (ClCH <sub>2</sub> CH <sub>2</sub> Cl) K00525000	1,2-dichloroethane CAS #107-06-2	50, C 100/1 STEL 2/10
Hexachloroethane <sup>bc</sup> (CCl <sub>3</sub> CCl <sub>3</sub> ) K14025000	perchloroethane CAS #67-72-1	1 (skin)/1/1 (skin)
1,1,1-Trichloroethane (CH <sub>3</sub> CCl <sub>3</sub> ) KJ2975000	methyl chloroform CAS #71-55-6	350/C 350/350, STEL 450
Tetrachloroethylene <sup>ab</sup> (Cl <sub>2</sub> C=CCl <sub>2</sub> ) KC3850000	perchloroethylene CAS #127-18-4	100, C 200, P 300/0.4 (LOQ)/ 25, STEL 100
1,1,2-Trichloroethane <sup>ad</sup> (Cl <sub>2</sub> CHCH <sub>2</sub> Cl) KJ3150000	vinyl trichloride CAS #79-00-5	10 (skin)/10 (skin)/10 (skin)
1,2,3-Trichloropropane <sup>a</sup> (CH <sub>2</sub> ClCHClCH <sub>2</sub> Cl) TZ9275000	allyl trichloride glycerol trichlorohydrin CAS #96-18-4	50/10 (skin)/10 (skin)

<sup>a</sup>Suspect carcinogen [20,21,22]; <sup>b</sup>Group I Pesticide; <sup>c</sup>Group II Pesticide; <sup>d</sup>Group III Pesticide

TABLE 2 PHYSICAL PROPERTIES

Compound RTECS	MW	mg/m <sup>3</sup> = 1 ppm @ NTP	Synonyms	Properties
Benzyl chloride (C <sub>6</sub> H <sub>5</sub> CH <sub>2</sub> Cl)	126.58	5.17	(chloromethyl) benzene -chlorotoluene	liquid BP 179 °C MP -48 to -43 °C d 1.100 @ 20 °C flash pt 67 °C
Bromoform (CHBr <sub>3</sub> )	252.75	10.33	tribromomethane	liquid d 2.887 BP 148 °C nonflammable
Carbon tetrachloride (CCl <sub>4</sub> )	153.84	6.29	tetrachloromethane	liquid d 1.585 BP 76.7 °C FP -23.0 °C VP 91.3 mm @ 20 °C vapor density (air = 1) 5.3
Chlorobenzene (C <sub>6</sub> H <sub>5</sub> Cl)	112.56	4.60	monochlorobenzene phenyl chloride	liquid d 1.105 @ 25 °C BP 131.6 °C MP -45 °C flash pt 29.4 °C (CC)
Chlorobromomethane (CH <sub>2</sub> BrCl)	129.39	5.29	bromochloromethane Halon 1011	liquid d 1.93 @ 20 °C BP 68 °C MP -88 °C nonflammable
Chloroform (CHCl <sub>3</sub> )	119.39	4.88	trichloromethane	liquid d 1.485 @ 20 °C BP 61.2 °C FP -63.5 °C
<i>o</i> -Dichlorobenzene (1,2-C <sub>6</sub> H <sub>4</sub> Cl <sub>2</sub> )	147.00	6.01	1,2-dichlorobenzene	liquid d 1.284 BP 172 to 179 °C FP -17 °C flash pt 65.5 °C
<i>p</i> -Dichlorobenzene (1,4-C <sub>6</sub> H <sub>4</sub> Cl <sub>2</sub> )	147.00	6.01	1,4-dichlorobenzene	solid crystals d 1.458 BP 173.7 °C MP 53 °C sublimates flash pt 65.5 °C
1,1-Dichloroethane (CH <sub>3</sub> CHCl <sub>2</sub> )	98.95	4.05	ethylidene chloride	liquid d 1.174 @ 20 °C BP 57 to 59 °C FP -98 °C
1,2-Dichloroethylene (ClCH=CHCl)	96.94	3.96	acetylene dichloride 1,2-dichloroethene	liquid trans-isomer d 1.257 BP 47 to 49 °C MP -57 °C cis-isomer d 1.282, BP 58 to 60 °C flash pt 3.9 °C FP -80 °C
Ethylene dichloride (ClCH <sub>2</sub> CH <sub>2</sub> Cl)	98.96	4.05	1,2-dichloroethane	liquid d 1.2554 @ 20 °C BP 83.5 °C FP -35.5 °C flash pt. 13 °C explosive limits in air 6 to 16%
Hexachloroethane (CCl <sub>3</sub> CCl <sub>3</sub> )	236.74	9.66	perchloroethane	solid d 2.091 MP 185 °C BP sublimates at 187 °C
1,1,1-Trichloroethane (CH <sub>3</sub> CCl <sub>3</sub> )	133.42	5.45	methyl chloroform	liquid d 1.325 BP 75 °C FP -30.4 °C nonflammable
Tetrachloroethylene (Cl <sub>2</sub> C=CCl <sub>2</sub> )	165.83	6.78	perchloroethylene	liquid d 1.625 @ 20 °C BP 121 °C FP -22.4 °C
1,1,2-Trichloroethane (Cl <sub>2</sub> CHCH <sub>2</sub> Cl)	133.41	5.45	vinyl trichloride	liquid d 1.4432 @ 20 °C BP 113.7 °C FP -36.4 °C VP 19 mm Hg @ 20 °C
1,2,3-Trichloropropane (CH <sub>2</sub> ClCHClCH <sub>2</sub> Cl)	147.43	6.03	allyl trichloride glycerol trichlorohydrin	liquid d 1.3888 @ 20 °C BP 156.2 °C FP -15 °C flash pt 82.2 °C (OC)

TABLE 3 SAMPLING LIMITS

Compound	Air Sample Volume (L)		Target	Working Range ppm at Max Sample Volume
	Min	Max		
Benzyl chloride	6 @ 1 ppm	50	10	0.6 to 5.8
Bromoform	4 @ 0.5 ppm	70	10	0.2 to 4
Carbon tetrachloride	3 @ 10 ppm	150	15	2 to 105
Chlorobenzene	15 @ 75 ppm	40	10	10 to 430
Chlorobromomethane	0.5 @ 200 ppm	8	5	18 to 450
Chloroform	1 @ 50 ppm	50	15	2 to 190
o-Dichlorobenzene	1 @ 50 ppm	60	3	16 to 1100
p-Dichlorobenzene	1 @ 75 ppm	10	3	27 to 330
1,1-Dichloroethane	0.5 @ 100 ppm	15	10	4 to 250
1,2-Dichloroethylene	0.2 @ 200 ppm	5	3	16 to 560
Ethylene dichloride	1 @ 50 ppm	50	3	16 to 1320
Hexachloroethane	3 @ 1 ppm	70	10	0.3 to 8.3
1,1,1-Trichloroethane	0.1 @ 350 ppm	8	3	18 to 1450
Tetrachloroethylene	0.2 @ 100 ppm	40	3	9 to 1900
1,1,2-Trichloroethane	2 @ 10 ppm	60	10	1.8 to 64
1,2,3-Trichloropropane	0.6 @ 50 ppm	60	10	3 to 310

TABLE 4 MEASUREMENT PARAMETERS.

Compound	Column*	Temp. (°C)	Range (mg per sample)
		Column/Injector/Detector	
Benzyl chloride	A	160/170/210	0.02 to 0.15
Bromoform	A	130/170/210	0.02 to 0.15
Carbon tetrachloride	B	60/155/200	0.2 to 7
Chlorobenzene	A	105/190/250	0.4 to 10
Chlorobromomethane	A	80/170/210	0.5 to 15
Chloroform	B	75/155/200	0.4 to 11
o-Dichlorobenzene	C	140/225/250	0.1 to 3
p-Dichlorobenzene	A	140/225/275	0.2 to 4
1,1-Dichloroethane	A	50/100/175	0.4 to 12
1,2-Dichloroethylene	A	60/170/210	0.2 to 7
Ethylene dichloride	C	70/225/250	0.1 to 4
Hexachloroethane	D	110/170/210	0.02 to 0.3
1,1,1-Trichloroethane	C	70/225/250	0.6 to 17
Tetrachloroethylene	C	90/225/250	0.4 to 12
1,1,2-Trichloroethane	C	70/250/225	0.05 to 2
1,2,3-Trichloropropane	E	160/180/230	0.3 to 9

\*A = 3 m x 3-mm OD stainless steel 10% SP 1000 on 80/100 mesh Chromosorb WHP

B = 6 m x 3-mm OD otherwise same as A.

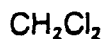
C = 3 m x 3-mm OD stainless steel, 10% OV-101 on 100/120 mesh Chromosorb WHP

D = 3 m x 6-mm OD glass, 3% SP-2250 on 80/100 mesh Chromosorb WHP

E = 3 m x 3-mm OD stainless steel 10% FFAP on 80/100 mesh Chromosorb WHP

# METHYLENE CHLORIDE

1005



MW 84.94

CAS 75-09-2

RTECS PA8050000

METHOD 1005 Issue 3

EVALUATION FULL

Issue 1 15 February 1984

Issue 3 15 August 1994

OSHA 500 ppm C 1000 ppm P 2000 ppm  
NIOSH lowest feasible carcinogen  
ACGIH 50 ppm suspect carcinogen  
(1 ppm = 3.47 mg/m<sup>3</sup> @ NTP)

## PROPERTIES

liquid d 1.323 g/mL @ 20 °C  
BP 40 °C MP -95 °C VP 47 kPa  
(349 mm Hg 46% v/v) @ 20 °C  
not flammable

SYNONYMS dichloromethane methylene dichloride

SAMPLING		MEASUREMENT	
SAMPLER	SOLID SORBENT TUBES (2 coconut shell charcoal tubes 100 mg and 50 mg)	TECHNIQUE	GAS CHROMATOGRAPHY FID
FLOW RATE	0.01 to 0.2 L/min	ANALYTE	methylene chloride
VOL MIN	0.5 L @ 500 ppm	DESORPTION	1 mL CS <sub>2</sub> stand 30 min
MAX	2.5 L	INJECTION VOLUME	5 µL
SHIPMENT	separate front and backup tubes	TEMPERATURE INJECTION	200 to 225 °C
SAMPLE STABILITY	not determined	DETECTOR	250 °C
BLANKS	2 to 10 field blanks per set	-COLUMN	60 to 90 °C
ACCURACY		CARRIER GAS	N <sub>2</sub> or He 30 mL/min
RANGE STUDIED	1700 to 7097 mg/m <sup>3</sup> (1 L samples) [1]	COLUMN	3 m x 3-mm ID stainless steel 10% SP 1000 on 80/100 mesh Chromosorb WHP
BIAS	- 4.1%	CALIBRATION	standard solutions of CH <sub>2</sub> Cl <sub>2</sub> in CS <sub>2</sub> with internal standard
OVERALL PRECISION ( $\bar{S}_r$ )	0.073 [1]	RANGE	0.03 to 10 mg per sample [2]
ACCURACY	± 14.1%	ESTIMATED LOD	0.01 mg per sample [3,4]
		PRECISION ( $\bar{S}_r$ )	0.026 @ 1.3 to 5.3 mg per sample [1]

APPLICABILITY The working range is 9 to 3000 ppm (30 to 10,400 mg/m<sup>3</sup>) for a 1-L air sample. The method is applicable to ceiling determinations.

INTERFERENCES None identified. The method was validated using a 6 m x 3-mm ID stainless steel column packed with 10% FFAP on 100/120 mesh Supelcoport. Alternate chromatographic columns are 10% TCEP on 80/100 Chromosorb PAW SP 2100 SP 2100 with 0.1% Carbowax 1500 or DB-1 fused silica capillary column.

OTHER METHODS This revises Methods S329 [2] 1005 (dated 2/15/84) P&CAM 127 [3] and the criteria document method [5]. OSHA Method 59 uses larger (350 mg) sorbent sections and has been evaluated for 10-L air samples at 1 ppm methylene chloride [6].

## REAGENTS

- 1 Eluent carbon disulfide,\* chromatographic quality containing % v/v decane, benzene or other suitable internal standard
- 2 Methylene chloride
- 3 Nitrogen or helium purified
- 4 Hydrogen prepurified
- 5 Air filtered compressed

\* See SPECIAL PRECAUTIONS

## EQUIPMENT

- 1 Sampler separate front and backup glass tubes with plastic caps, 7 cm long 6-mm OD 4-mm ID flame-sealed ends, containing activated (600 °C) coconut shell charcoal (front = 100 mg back = 50 mg) A silylated glass wool plug is placed at each end of each tube Pressure drop across the tubes at 1 L/min airflow must be less than 3.4 kPa  
NOTE. Two commercially available tubes each containing 150 mg charcoal in two beds, may be used in tandem
- 2 Personal sampling pump, 0.01 to 0.2 L/min with flexible connecting tubing
- 3 Gas chromatograph flame ionization detector integrator and column (page 1005-1)
- 4 Vials 2-mL, PTFE-lined septum crimp caps
- 5 Syringe, 10- $\mu$ L, readable to 0.1  $\mu$ L
- 6 Volumetric flasks, 10-mL

**SPECIAL PRECAUTIONS** Carbon disulfide is toxic and a serious fire and explosion hazard (flash point = -30 °C) work with it only in a hood

## SAMPLING

- 1 Calibrate each personal sampling pump with a representative sampler in line
- 2 Break ends of sampler immediately before sampling. Connect the two sorbent tubes with a short piece of flexible tubing. Attach sampler to personal sampling pump with flexible tubing
- 3 Sample at an accurately known flow rate between 0.01 and 0.2 L/min for a total sample size of 0.5 to 2.5 L
- 4 Separate the front and backup tubes and cap each tube to prevent migration of methylene chloride between tubes Pack securely for shipment.

## SAMPLE PREPARATION

- 5 Place the front and back sorbent sections (i.e. front and backup tubes) of the sampler in separate vials. Discard the glass wool and foam plugs.
- 6 Add 1.0 mL eluent to each vial Attach crimp cap to each vial
- 7 Allow to stand 30 min with occasional agitation

## CALIBRATION AND QUALITY CONTROL

- 8 Calibrate daily with at least six working standards over the range 0.01 to 10 mg methylene chloride per sample.
  - a. Add known amounts of methylene chloride to eluent in 10-mL volumetric flasks and dilute to the mark
  - b. Analyze together with samples and blanks (steps 11 and 12)
  - c. Prepare calibration graph (ratio of peak area of analyte to peak area of internal standard vs mg methylene chloride)



- 9 Determine desorption efficiency (DE) at least once for each lot of charcoal used for sampling in the calibration range (step 8) Prepare three tubes at each of five levels plus three media blanks
  - a Remove and discard back sorbent section of a media blank sampler
  - b Inject a known amount of methylene chloride directly onto front sorbent section with a microliter syringe
  - c Cap the tube Allow to stand overnight
  - d Desorb (steps 5 through 7) and analyze together with working standards (steps 11 and 12)
  - e Prepare a graph of DE vs mg methylene chloride recovered
- 10 Analyze three quality control blind spikes and three analyst spikes to insure that the calibration graph and DE graph are in control

## MEASUREMENT

- 11 Set gas chromatograph according to manufacturer's recommendations and to conditions given on page 1005 1 Inject sample aliquot manually using solvent flush technique or with autosampler  
NOTE If peak area is above the linear range of the working standards dilute with eluent reanalyze and apply the appropriate dilution factor in calculations
- 12 Measure peak area Divide the peak area of analyte by the peak area of internal standard on the same chromatogram

## CALCULATIONS

- 13 Determine the mass mg (corrected for DE) of methylene chloride found in the sample front ( $W_f$ ) and back ( $W_b$ ) sorbent sections and in the average media blank front ( $B_f$ ) and back ( $B_b$ ) sorbent sections  
NOTE If  $W_b > W_f/10$  report breakthrough and possible sample loss
- 14 Calculate concentration  $C$  of methylene chloride in the air volume sampled  $V$  (L)

$$C = \frac{(W_f + W_b - B_f - B_b) \cdot 10^3}{V}, \text{ mg/m}^3$$

## EVALUATION OF METHOD

Method S329 [2] was issued on June 6 1975 and validated over the range 1700 to 7100 mg/m<sup>3</sup> at 25 °C and 763 mm Hg using a 1 L sample [1] Overall precision  $\bar{S}_r$  was 0.073 with average recovery 95.3% representing a non significant bias The concentration of methylene chloride was independently verified by calibrated syringe pump Desorption efficiency was 0.97 in the range 1.3 mg to 5.3 mg methylene chloride per sample Breakthrough (5% on back section) occurred at 18.5 min when sampling an atmosphere containing 6726 mg/m<sup>3</sup> methylene chloride at 0.187 L/min at 0% RH The stability of methylene chloride on charcoal was not determined The method was used in NIOSH Sequences #7745 (4/8/93) #7620N (2/16/93) #7716M (1/22/93) and #7716F (1/21/93) [7]

## REFERENCES

- [1] Documentation of the NIOSH Validation Tests NIOSH S329 U.S. Department of Health Education and Welfare Publ. (NIOSH) 77-185 (1977)
- [2] NIOSH Manual of Analytical Methods 2nd ed. V. 3 S329 U.S. Department of Health Education and Welfare Publ. (NIOSH) 77-157 C (1977)
- [3] NIOSH Manual of Analytical Methods 2nd ed. V. 1 P&CAM 127 U.S. Department of Health Education and Welfare Publ. (NIOSH) 77-157 A (1977)
- [4] User check UBTL, NIOSH Sequence #3990 R (unpublished November 3 1983)

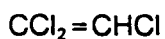
- [5] Criteria for a Recommended Standard Occupational Exposure to Methylene Chloride U S Department of Health, Education, and Welfare Publ (NIOSH) 76-138 (1976)
- [6] OSHA Method 59
- [7] NIOSH Sequences (unpublished) (1993)

**METHOD REVISED BY**

G David Foley and Y T Gagnon, NIOSH/DPSE S329 originally validated under NIOSH Contract CDC 99-74-45

# TRICHLOROETHYLENE

1022



MW 131.39

CAS 79-01-6

RTECS KX4550000

METHOD 1022, Issue 2

EVALUATION PARTIAL

Issue 1 15 August 1987

Issue 2: 15 August 1994

OSHA 100 ppm C 200 ppm P 300 ppm  
 NIOSH 25 ppm C 2 ppm/1 h (waste anesthetic)  
 suspect carcinogen Group 1 Pesticide  
 ACGIH 50 ppm STEL 200 ppm suspect carcinogen  
 (1 ppm = 5.37 mg/m<sup>3</sup> @ NTP)

## PROPERTIES

liquid d 1.46 g/mL @ 20 °C  
 BP 87 °C MP -86 °C VP 9.9 kPa  
 (74 mm Hg 9.8% v/v) @ 25 °C  
 explosive range 11 to 41% v/v in air

SYNONYMS trichloroethene ethylene trichloride triclene

SAMPLING		MEASUREMENT	
SAMPLER	SOLID SORBENT TUBE (coconut shell charcoal 100 mg/50 mg)	TECHNIQUE	GAS CHROMATOGRAPHY FID
FLOW RATE	0.01 to 0.2 L/min	ANALYTE	trichloroethylene
VOL MIN	1 L @ 100 ppm	DESORPTION	1 mL CS <sub>2</sub> stand 30 min
MAX.	30 L	INJECTION VOLUME	5 µL
SHIPMENT	routine	TEMPERATURE INJECTION	225 °C
SAMPLE STABILITY	not determined	DETECTOR	250 °C
BLANKS	2 to 10 field blanks per set	-COLUMN	70 °C
ACCURACY		CARRIER GAS	N <sub>2</sub> 30 mL/min
RANGE STUDIED	477 to 2025 mg/m <sup>3</sup> (3 4-L samples) [1]	COLUMN	3 m x 3-mm OD stainless steel packed with 10% OV 101 on 100/200 mesh Chromosorb WHP
BIAS	- 7.19%	CALIBRATION	standard solutions of trichloroethylene in CS <sub>2</sub>
OVERALL PRECISION (S <sub>r</sub> )	0.082 [1]	RANGE	0.5 to 10 mg per sample
ACCURACY	± 19.78%	ESTIMATED LOD	0.01 mg per sample [2]
		PRECISION (S <sub>s</sub> )	0.038 @ 1.6 to 6.4 mg per sample [1]

**APPLICABILITY** The working range is 27 to 875 ppm (150 to 4700 mg/m<sup>3</sup>) for a 3 4-L air sample. The method is applicable to STEL determinations. The method was used for samples containing 0.5 to 5 mg trichloroethylene from a tool-degreasing operation [2].

**INTERFERENCES** None studied. Alternate columns which have been used are stainless steel 6 m x 3 mm OD packed with 10% SP 1000 on 80/100 mesh Supelcoport [2] and fused silica capillary 60 m x 0.32 mm coated with 0.25 µm OV-351 [3].

**OTHER METHODS** This combines and revises methods S336 [4] and P&CAM 127 [5]. The criteria document method is similar [6]. NIOSH Method 3701 uses a portable gas chromatograph for field readout.

**REAGENTS**

- 1 Carbon disulfide (CS<sub>2</sub>) chromatograph quality \*
- 2 Trichloroethylene (TCE) reagent grade \*
- 3 Nitrogen, purified
- 4 Hydrogen prepurified
- 5 Air filtered compressed

\* See SPECIAL PRECAUTIONS

**EQUIPMENT**

- 1 Sampler glass tube 7 cm long 6 mm OD 4 mm ID flame-sealed ends with plastic caps containing two sections of 20/40 mesh activated (600 °C) coconut shell charcoal (front = 100 mg back = 50 mg) separated by a 2 mm urethane foam plug. A silylated glass wool plug precedes the front section and a 3 mm urethane foam plug follows the back section. Pressure drop across the tube at 1 L/min airflow must be less than 3.4 kPa. Tubes are commercially available.
- 2 Personal sampling pump, 0.01 to 0.2 L/min with flexible connecting tubing.
- 3 Gas chromatograph, flame ionization detector integrator, and column (see page 1022.1)
- 4 Vials, 2-mL, PTFE-lined septum caps
- 5 Syringes, 10- $\mu$ L, readable to 0.1  $\mu$ L
- 6 Volumetric flasks, 10-mL
- 7 Pipet, TD 1-mL

**SPECIAL PRECAUTIONS** Carbon disulfide is toxic and a serious fire and explosion hazard (flash point = -30 °C). Trichloroethylene is a suspect carcinogen and a narcotic [678]. Work with these substances only in a hood.

**SAMPLING**

- 1 Calibrate each personal sampling pump with a representative sampler in line.
- 2 Break the ends of the sampler immediately before sampling. Attach sampler to personal sampling pump with flexible tubing.
- 3 Sample at an accurately known flow rate between 0.01 and 0.2 L/min for a total sample size of 1 to 30 L.
- 4 Cap the samplers. Pack securely for shipment.

**SAMPLE PREPARATION**

- 5 Place the front and back sorbent sections of the sampler tube in separate vials. Discard the glass wool and foam plugs.
- 6 Add 1.0 mL CS<sub>2</sub> to each vial. Cap each vial.  
NOTE A suitable internal standard, such as ethylbenzene [1] undecane [2] or octane [3] at 0.1% (v/v) may be added at this step.
- 7 Allow to stand 30 min with occasional agitation.

**CALIBRATION AND QUALITY CONTROL**

- 8 Calibrate daily with at least six working standards
  - a Add known amounts of TCE to CS<sub>2</sub> in 10-mL volumetric flasks and dilute to the mark. Use serial dilutions as needed to obtain TCE concentrations in the range 0.01 to 10 mg/mL.
  - b Analyze with samples and blanks (steps 11 and 12)
  - c Prepare calibration graph (peak area vs. mg TCE)

- 9 Determine desorption efficiency (DE) at least once for each lot of sorbent used for sampling in the range of interest Prepare three tubes at each of five concentrations plus three media blanks
  - a Remove and discard back sorbent section of a media blank sampler
  - b Inject a known amount (2 to 20  $\mu\text{L}$ ) of TCE or a standard solution thereof in  $\text{CS}_2$  directly onto front sorbent section with a microliter syringe
  - c Cap the tube Allow to stand overnight
  - d Desorb (steps 5 through 7) and analyze with working standards (steps 11 and 12)
  - e Prepare a graph of DE vs mg TCE recovered
- 10 Analyze three quality control blind spikes and three analyst spikes to ensure that the calibration graph and DE graph are in control

## MEASUREMENT

- 11 Set gas chromatograph according to manufacturer's recommendations and to conditions given on page 1022.1 Inject sample aliquot manually using solvent flush technique or with autosampler
 

NOTE If peak area is above the linear range of the working standards dilute an aliquot of the desorbed liquid with  $\text{CS}_2$  reanalyze and apply the appropriate dilution factor in calculations
- 12 Measure peak area

## CALCULATIONS

- 13 Determine the mass mg (corrected for DE) of TCE found in the sample front ( $W_f$ ) and back ( $W_b$ ) sorbent sections and in the average media blank front ( $B_f$ ) and back ( $B_b$ ) sorbent sections
 

NOTE If  $W_b > W_f/10$  report breakthrough and possible sample loss
- 14 Calculate concentration  $C$  of TCE in the air volume sampled  $V$  (L)

$$C = \frac{(W_f + W_b - B_f - B_b) \cdot 10^3}{V}, \text{ mg/m}^3$$

## EVALUATION OF METHOD

Method S336 was issued on June 6 1975 [4] and validated with generated atmospheres using a calibrated syringe drive [1] Average recoveries were 92 to 94% (16 samples) in the range 477 to 2025  $\text{mg/m}^3$  for 3.4 L samples Breakthrough volume of 18.5 L (effluent = 5% of test concentration) occurred after sampling for 99 min at 0.187 L/min from an atmosphere containing 2266  $\text{mg/m}^3$  trichloroethylene in dry air Desorption efficiency for SKC Lot 105 activated coconut charcoal in the range 1.6 to 6.4 mg per sample averaged 96.4% with  $S_d = 0.7\%$  (18 samples) n-Octane was used as an internal standard in the chromatographic measurements The semi-quartile ranges of desorption efficiencies in two rounds of the Proficiency Analytical Testing (PAT) program were 0.97 to 1.0 for charcoal tubes spiked with 0.6 to 1.1 mg trichloroethylene [9]

## REFERENCES

- [1] Documentation of the NIOSH Validation Tests S336 U.S. Department of Health Education and Welfare Publ. (NIOSH) 77-185 (1977) available at Stock No. PB 274 248 from NTIS Springfield VA 22161
- [2] UBTL Report for NIOSH Sequence #4266 R (NIOSH unpublished March 26 1984)
- [3] UBTL Report for NIOSH Sequence #4266 N (NIOSH unpublished March 14 1984)

- [4] NIOSH Manual of Analytical Methods, 2nd ed Vol 3, S336, U S Department of Health, Education and Welfare, Publ (NIOSH) 77 157-C (1977)
- [5] Ibid Vol 1 P&CAM 127 U S Department of Health Education and Welfare, Publ. (NIOSH) 77 157 A (1977)
- [6] Criteria for a Recommended Standard Occupational Exposure to Trichloroethylene U S Department of Health Education, and Welfare Publ (NIOSH) 73-11025 (1973)
- [7] NIOSH Current Intelligence Bulletin 2 Trichloroethylene (TCE) NIOSH (June 6 1975) U S Department of Health Education, and Welfare Publ (NIOSH) 78-127 (1978)
- [8] Special Occupational Hazard Review with Control Recommendations - Trichloroethylene U S Department of Health Education, and Welfare Publ (NIOSH) 78-130 (1978)
- [9] Groff J Personal communication NIOSH (July 1985)

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